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SACANDAGA RESERVOIR. SEE PAGE 70

THE TECHNOLOGY REVIEW

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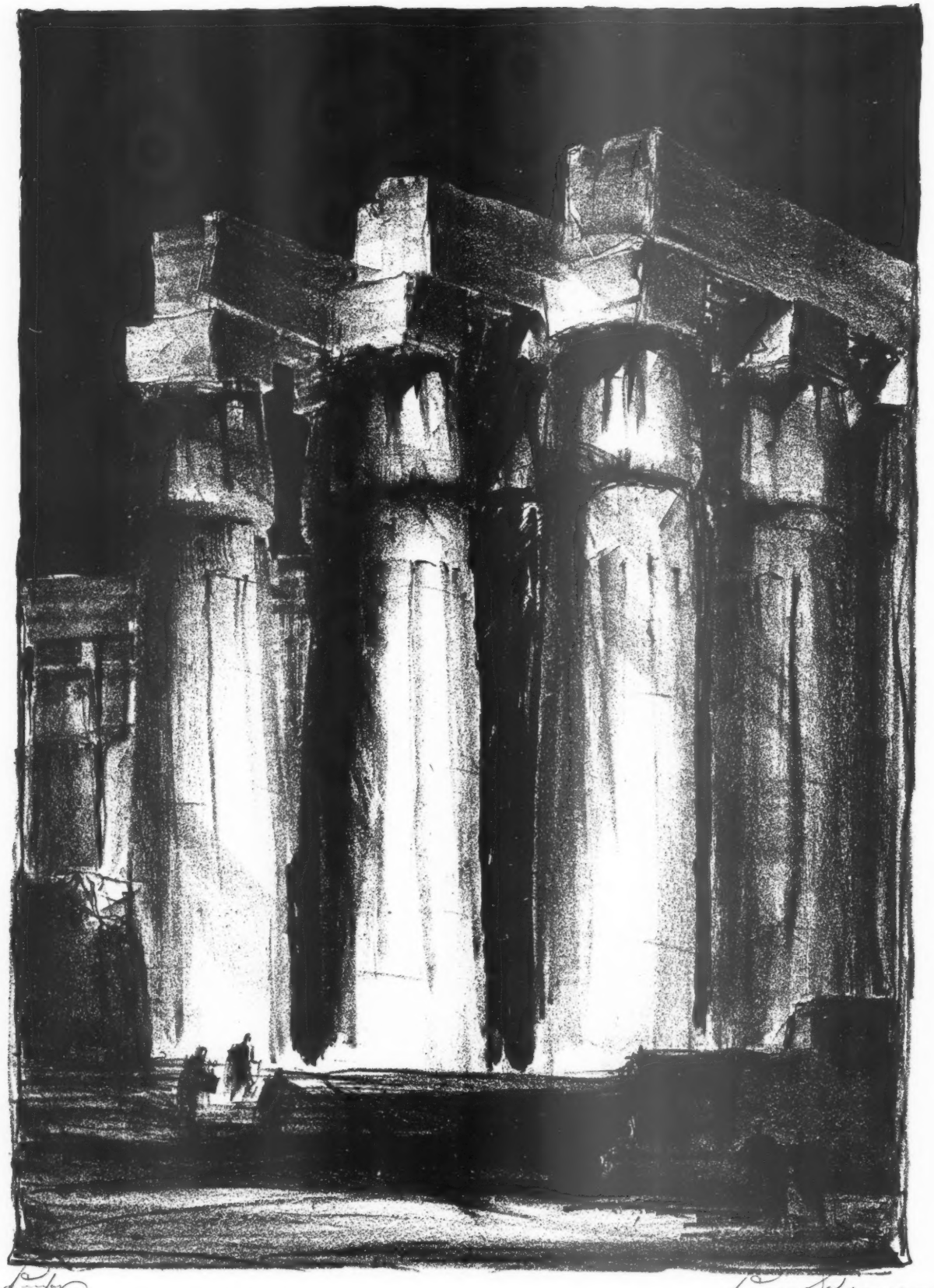
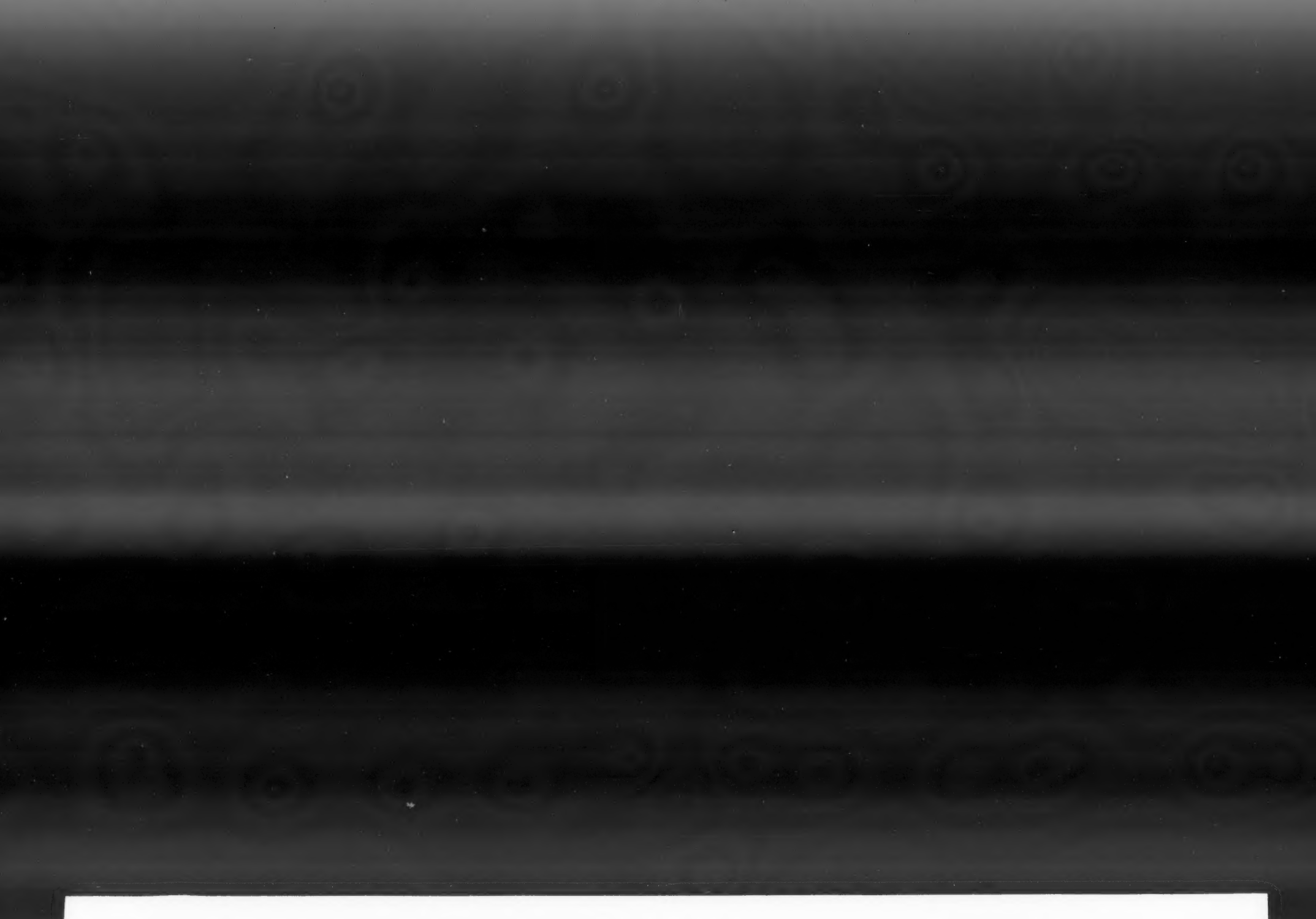




THE TECHNOLOGY
REVIEW
VOLUME 33 NOVEMBER, 1930 NUMBER 2

PROMETHEUS ENCHAINED

Today the Greatest Need in All the Bewildered World Is for Philosopher Engineers

BY STUART CHASE

I ONCE wrote a book and ended it with these lines: "Prosperity in any deeper sense awaits the liberation of the engineer. If the owners will not get off his back I, for one, would not be sorry to see him combine with the wayfaring man to lift them off. A complicated technical structure should be run by engineers, not hucksters. But the technician is the modern Prometheus in chains."

I have been asked to be more explicit. It is good to end a book with a round, ringing climax, but not quite so good to be forced to explain all its implications. I recognize, however, my responsibility in the premises. I said flatly enough that I preferred engineers to business men as directors of our economic destinies, and it is clearly my duty to state the reasons.

Since James Watt tinkered with Newcomen's engine, the technician has been increasingly interfering with our food supply, and indeed with the whole economic structure. He has completely undermined the self-supporting village and the economically independent local community, over all of Western civilization, and is in the process of devitalizating it throughout the rest of the world. A few months ago in Mexico I saw the fresh cuts and fills of motor roads scarring the mountain sides, and cement foundations laid for high-power transmission lines. I knew that the end of the balanced Aztec economy was near. There has been a great deal of loose talk about "progress," "prosperity," "the torch of science"; but the complete uprooting of the age-old contact between the wayfaring man and his environment is a pretty serious business; far more serious indeed than the Prosperity Chorus has ever stopped to realize in its mad dash toward the goal of the bigger and better.

Galloway

"THE HIGHEST BUILDING"

What has happened in essence is this: before Watt, the majority of men and women everywhere were capable of providing their own food, shelter, clothing and entertainment in whatever locality they found themselves. They were steeped in the tradition of wresting their own necessities from the soil, the waters, the forests about them. They may have done it with deplorable inefficiency, but they did it. Shipwreck a group of them on an uninhabited but fertile island, and they knew how to carry on.

Year by year since 1765, the mass of mankind has been losing the ability to carry on. Shipwreck an assorted crew of bookkeepers, truck drivers, machinists and advertising men on an uninhabited but fertile island, and I would not give them two months' survival. The advertising section would hold some splendid conferences and inscribe some spirited programs, but nobody would know how to do anything. Unless by some happy chance one of the bookkeepers was a truck gardener on the side. Today the millions live in total and sublime ignorance of the forces which feed, shelter and clothe them. For all they know, switches produce light, and chain stores food. The functioning of the ecomonic process rests in the heads of a few thousand highly trained experts; in *your* heads, if you please. Is it too much to say that if a hundred key technicians left their posts they could seriously cripple, if not positively terminate, the functioning of a great city like New York? To make matters even more potentially precarious, each expert is so highly specialized that he has little if any conception of the work of the others. There is no General Staff, understanding the whole process, and correlating the vital nerves of transportation, communication, power, water, food supply,

Margaret Bourke-White

"... SPECIALIZATION MAKES FOR ECONOMIES ... BUT IT ALSO MAKES FOR A HIGHLY COMPLICATED NERVOUS SYSTEM, A CERTAIN TECHNOLOGICAL TENUOUSNESS"

which furnish the economic substratum of the modern community.

Specialization makes for economies, sometimes prodigious economies, as the Progress Boys are tireless in pointing out. But it also makes for a highly complicated nervous system, a certain technological tenuousness, which carries a threat greater than anything we have known before. Indeed, a whole series of threats, including:

Technological unemployment
Mechanized warfare — particularly the three-dimensional attack of the bombing airplane
Social standardization
Over-rapid exhaustion of natural resources
The creation of a factory robot class
Second-hand rather than participating recreation forms
The compulsion of speed, with consequent deleterious effects on the human nervous system

I am enough of a Progress Boy myself to admit, somewhat grudgingly to be sure, that I am glad James Watt did some tinkering. (If he had not, another bright young instrument maker would have invented a practicable steam engine, and that within a decade. The times demanded it, and it would have come.) By and large, we stand to gain more than we stand to lose by the emergence of the technical arts and the economic specialization which they have created. But this should not blind us to the chances taken and the risks involved. Some four million unemployed last winter must have frequently wished to be back in the handicraft age when unemployment was virtually unknown. (Provided that they knew any economic history — a dubious enough assumption.) All is far from the best in a moderately uncertain world — with just a chance that another first class war, or another decade of uncorrelated specialization, might wipe out the whole credit side of the ledger, and make us all wish to be back in a self-sufficient local economy.

In brief, you engineers have been raising considerable hell, along with your not altogether heavenly technical improvements in economic life. And the point I wish to stress is this: you have been doing the horse work while letting somebody else — chiefly the business man — take the responsibility. It seems to me that the responsibility should be squarely yours. By the same token, the credit — if credit there be — should be yours. You have played the shrinking violet long enough. You have remade Western civilization, and created at the same time certain malignant evils — actual, like technological unemployment; potential, like a smash-up due to over-specialization. You should shoulder the burden of mitigating these evils; which means directing the destinies of the new society that you have built. You are responsible for it; you are the only group in the community capable of understanding its highly complicated structure. Statesmen, philosophers, generals, poets, may lead self-supporting communities, but only engineers may lead a great, interlocked economic structure — with a score of exposed live arteries throbbing in every metropolitan area.

IN a sense the modern world is not led at all. It simply flounders. In the United States, for instance, we have a political government composed chiefly of office-seekers and chair warmers who have no more idea of the complexities they are supposed to direct than the man in the moon. Mr. Hoover may have some notion of them, but the aforementioned office-seekers have him both blockaded and frightened. The real action in the Republic is provided by business men affiliated with large corporate enterprises. A few of them, like Mr. Owen D. Young and Mr. Dwight Morrow, may possess some sense of state, to use the phrase of H. G. Wells, but the majority neither know nor care where the ship of state is headed.

The pursuit of profit is a stimulating adventure but an intensely narrow one. Rare is the business man who can look over the top of his own balance sheet; rare even the man who can plan for a balance sheet three years in advance. So far as the Republic moves, however, the man of business provides the driving force, leaving the statesman, the philosopher, the professor, the editor, the general, the parson, gloomily to contemplate the crowns which once they wore.

At the heel of the business man follows the engineer. The former says: Let there be light, and the latter provides it . . . Let there be a thousand oil wells (in a pool where wasteless exploitation requires but a hundred) and they are obediently drilled . . . Let there be the highest building in the world (to choke an already throttled Grand Central station) and it is built . . . Let there be an almost ultra-violet lamp (to sell to the millions who believe in advertising) and, brave in nickel and aluminum, it is properly constructed. . . .

YOU get the point. The engineer has built the modern world, but only at the bidding of his master's voice. The master knows not a crank shaft from a piston rod, but he knows what will sell; and is quick to see the profitable possibilities of every advance in pure science. The world is not planned by the business man, for he has no plan. It is not planned by the engineer, for hitherto that has never been his function. He has constructed endless detail — as directed — but the whole, whether it be the nation, an economic region, a city, a railway system, a coal basin, a single industry, a straight line marketing system, has never been relegated to his charge. As described in The Technology Review of last May, technicians are building in suburban New York a little town, ultimately to house 25,000 people, designed specifically for the motor age. So far as I know, this is the biggest single project involving a social-economic goal ever permitted to the engineering mind. (The Panama Canal was another, but that lies outside the country. In Russia today, the engineering mind has the disposal of some thirty-three billions of dollars for new construction during the next five years (*See page 76*). It will probably be the most convenient, comfortable, the safest, and perhaps the most sightly suburban town to live in that the nation has ever known. The business man has stepped aside — taking a modest six per cent — to let the engineer run the show.

It is my conviction that the engineer can run far bigger shows than the town of Radburn to the satisfaction of (1) the people who are to use them or work in them, (2) the investor, (3) himself, and (4) the technical requirements of the country's future development. Suppose, for instance, that broad-visioned engineers had had the past century in charge as directors — or co-directors if you will. Would they have permitted:

The depletion of our forests at a rate four times that of the annual growth?

The violation of all the laws of geology in the exploitation of petroleum pools?

The present criss-cross and duplication in the transportation system?

The neglect of cheaper waterways for the profitable exploitation of high cost railways?

The exhaustion and erosion of soils and the floods which follow after?

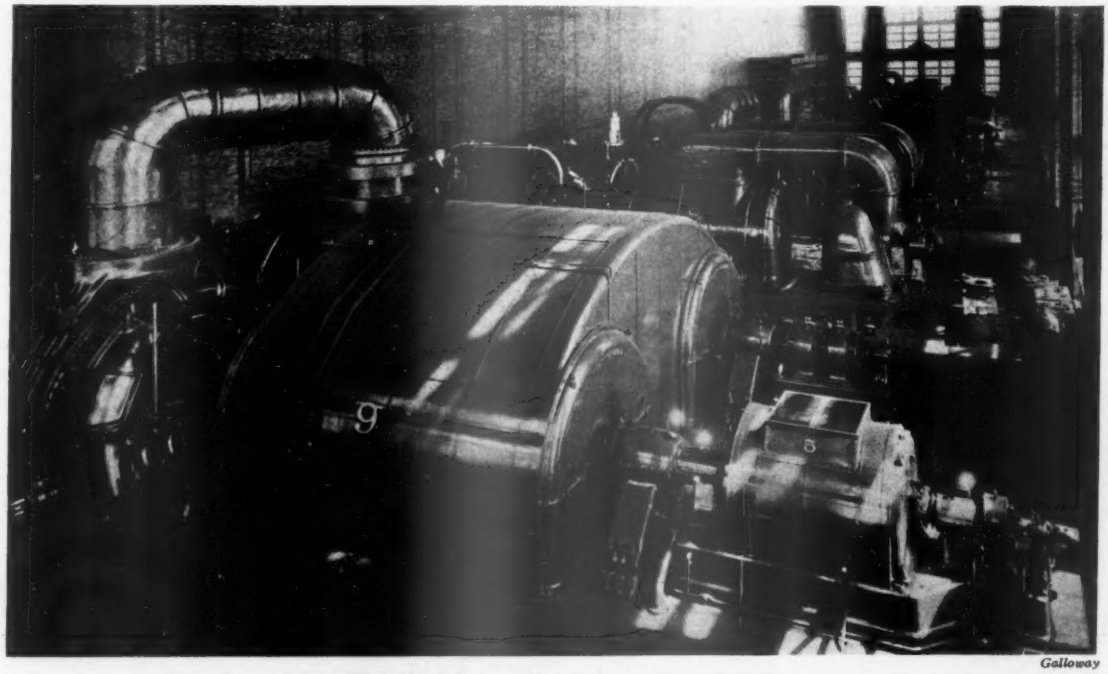
The jams, bottle necks and traffic tangles of metropolitan districts?

The building of skyscrapers faster than the means to empty and fill them?

The elephantiasis of New York City at the expense of other ports and other logical industrial and commercial centers?

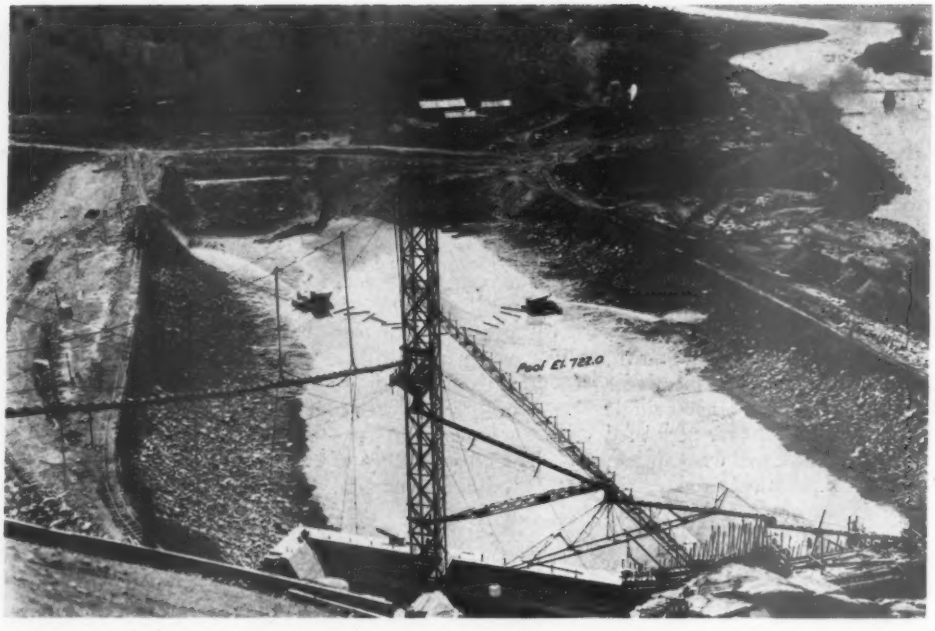
The cross-hauling of raw metals to Connecticut and finished brass back to the West again? Or, if you please, the desecration (to say nothing of the added accident rate) of every highway in the country with millions of square feet of cigarette, cosmetic, and soap appeals?

That a century of the engineering mind controlling, or helping to control, economic forces, would have made a wasteless world is, of course, highly problematical. The rate of obsolescence in the technical arts is so great that nothing can be planned with any finality. Mistakes would have been made; loss and leakage taken their toll. But I am inclined to believe that a good half of the manpower which now runs to waste might have been salvaged, with the result that poverty would have been quite finally abolished, unemployment (*Concluded on page 96*)



Galloway

"... IT IS A MIND THAT ... HAS THE COURAGE TO ACCEPT THE JOB OF TAMING THE BILLION WILD HORSES WHICH WATT LET LOOSE"



SLUICING THE ROCK FLOUR CORE OF THE CONKLINGVILLE DAM

HARNESSING

How a Recalcitrant River Is Being

By Edward

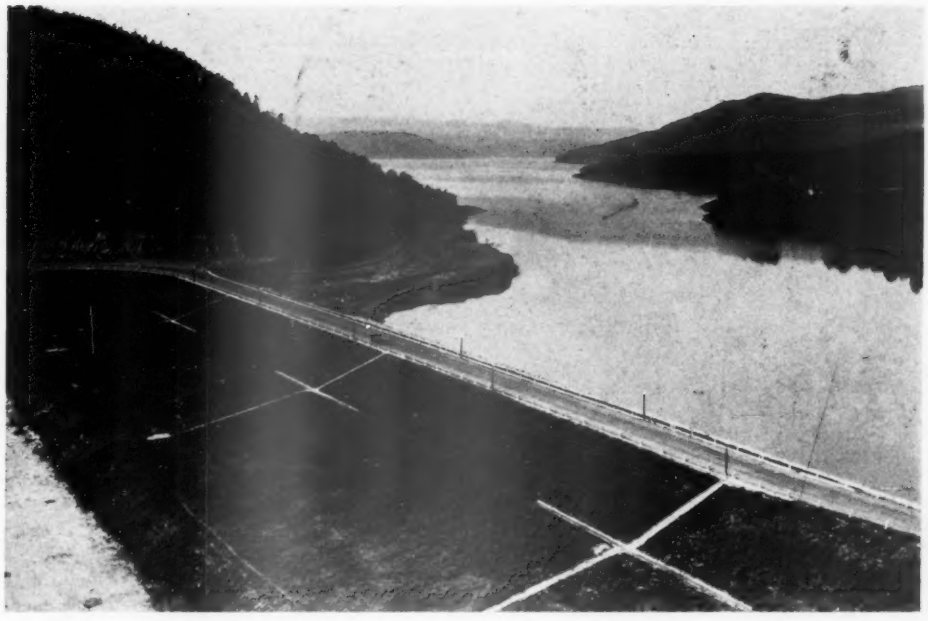
THE great floods in the Mississippi Valley and in New England during the past few years have brought vividly to public attention the need for minimizing these catastrophes. One of the most complete systems for controlling the flow of a river and thus guarding against floods is to be found in the state of New York where a system of reservoirs is being constructed to regulate the flow of the Hudson and Sacandaga Rivers. The largest unit in this system, the Sacandaga Reservoir, has been completed, and its success already demonstrated.

If the highest collected and permanent body of water be accepted as the head of a watershed, then the source of the Hudson River is Lake Tear-of-the-Clouds, which lies at an elevation of 4,322 feet above sea level. Feldspar Brook, the outlet of Lake Tear, flows into Opalescent River, thence to the Hudson River, and 300 miles to the Atlantic Ocean. It is interesting to note that practically all of the fall of the river occurs in the first 150 miles of its length, the last 150 miles from Albany to the ocean being tidewater. The watershed at Lake Tear is less than one square mile and at the confluence of the Hudson and Sacandaga Rivers about 2,700 square miles. The watershed is 8,100 square miles below the confluence of the Mohawk and 13,400 square miles at its mouth.

The annual precipitation varies considerably on the watershed, 38 inches at Albany, approximately 45 inches at Glens Falls and exceeding 60 inches in the higher reaches of the watershed. Thus nature has been lavish in giving a bountiful supply of water but, unfortunately, the distribution of flow has not been steady. A large part of the precipitation comes in the form of snow and remains on the watershed until spring thaws and rains cause a rapid runoff. The greatest flood in the known history of the Hudson River occurred on March 28, 1913, the river reaching a peak at Albany of 225,000 cubic feet per second, whereas in September of the same year the river dropped to less than 1,000 c.f.s.

Similar ratios between maxima and minima flows occur at points upstream on the river. The flood of 1913 reached at Albany an elevation of 22.4 feet above mean sea level,

BATCHELLERVILLE BRIDGE ACROSS SACANDAGA RESERVOIR



COMPLETED CONKLINGVILLE DAM IMPOUNDING THE SACANDAGA RESERVOIR

THE HUDSON

Tamed and Made a Greater Public Servant

H. SARGENT

over 20 feet higher than the low water stage. This flood did over $1,000,000 worth of physical damage in the vicinity of Albany, Troy, and Rensselaer, and the indirect damage was probably more. For example, the filtration plant which purifies the water supply of Albany was inundated and although the health authorities advised the boiling of water, many families failed to do so and a serious typhoid epidemic occurred. It is well known that following such an inundation many diseases occur due to the unsanitary conditions in the houses along the river banks, especially the detritus carried by the flood and the cold, damp after conditions. Although the 1913 flood was the most disastrous, other floods are frequent.

The damage from low flow in the river is perhaps as serious economically as the damage from floods, although less spectacular. There is, for example, an installation of water power plants along the Hudson River of 260,000 horse-power, yet in times of low flow only 35,000 horse-power can be generated. This means that public utilities must supply the deficiency of power from other sources, probably steam, and that paper and pulp mills must partially shut down their plants with serious loss to owners and employees. By the operation of the Sacandaga Reservoir, the minimum flow will be more than tripled, increasing the continuous power at existing plants to over 120,000 horse-power, and unsanitary conditions due to the excess pollution of the sewage and trade wastes will be greatly lessened by the improved regimen of flow.

This year's drought has afforded an exceptionally good opportunity to observe its beneficial effects. During the month of September, the flow of the Hudson River was approximately tripled by storage water released from the Sacandaga Reservoir, the average flow of the river at Glens Falls, N. Y., being 2,920 second feet, of which 1,870 second feet were released from this reservoir. The vastness of such a reservoir is brought out by the fact that during September it was only depleted 3.8 feet, which meant that 3.9 billion cubic feet of water were released during that period. This regulation was obtained despite the fact that the reservoir was filled last spring

THIS BRIDGE CONTAINS 19 SPANS, EACH 150 FEET LONG, AND TWO SPANS, EACH 75 FEET LONG

CONTROL-HOUSE, SPILLWAY CHANNEL, AND POWER-HOUSE AT THE CONKLINGVILLE DAM

only to an elevation of 760 feet, whereas in the future it will be filled to the crest of the spillway, an elevation of 771 feet. This latter elevation will give an available storage of 30 billion cubic feet, whereas this year the available storage is only 18 billion cubic feet.

Had this storage capacity been available during the flood of 1913, the peak flow at Glens Falls, 84,000 cubic feet per second, could have been reduced to 50,000 cubic feet a second, and the maximum flood water elevation at Albany could have been kept down nearly three feet. These facts demonstrate clearly the size and importance of the Sacandaga Reservoir and the efficacy of a reservoir storage system to prevent floods and even the flow of a great river.

What is the story behind the building of the Sacandaga Reservoir and the creation of the Hudson River Regulating District? In 1867 Mr. Samuel McElroy submitted a report to the New York State Legislature which contained the following suggestions:

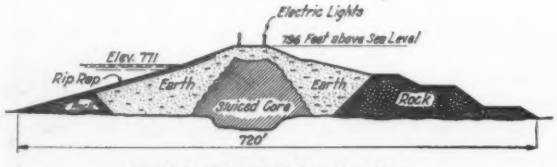
"In connection with this general subject, I have to suggest to your attention, the probable means of alleviating a very serious and increasing contingency. . . .

"It is well known to any resident of the Hudson above New Baltimore that the river is subject to very sudden and powerful spring freshets, which are aggravated by the ice movements. These freshets always cause great loss of property and its equivalents, in time and otherwise, and sometimes seriously jeopardize life. It would be difficult to estimate, in money, the annual cost they occasion, sometimes exceeding $250,000 at Albany and vicinity, and, by laws well known to hydraulic engineers, gradual cultivation and clearing of the country gives the rainfall a speedier delivery, and tends, in one direction, to increase flood discharge, while in another it reduces, through increased evaporation, the aggregate drainage delivery and summer flow.

"If, then, the conformation of the river banks in Warren and Essex counties is such as to facilitate the construction of dams of short lengths to form reservoirs of great capacity, a condition of which seems to be fully insured by the lake sources and succession of mountain gorges, it may be possible, with a moderate outlay, to modify and relieve these annual disasters."

Eugene L. Ashley of Glens Falls, who was a pioneer in water power development along the Hudson River and who as President of the Hudson River Water Power Company promoted and built the Spier Falls dam and power house, conceived the idea of a Sacandaga Reservoir, the storage from which would increase greatly the output of the Spier Falls plant. The reservoir was to be created by a dam at Conklingville, which is located in Saratoga County about six miles above the confluence of the Sacandaga and Hudson River, and this site was known for a number of years as Ashley Falls.

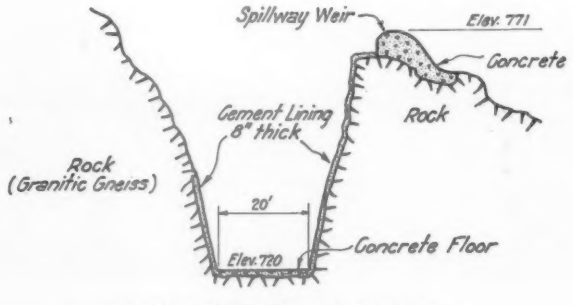
In accordance with Mr. Ashley's plans the Hudson River Water Power Company in 1900 began topographic and property surveys of the Sacandaga Reservoir basin, the surveys being made on the basis of a flow line at elevation 740 feet above sea level, it having been planned to raise the existing timber crib dam 24 feet. These surveys and also the borings for the dam foundation were of great value in the subsequent (*Continued on page 96*)



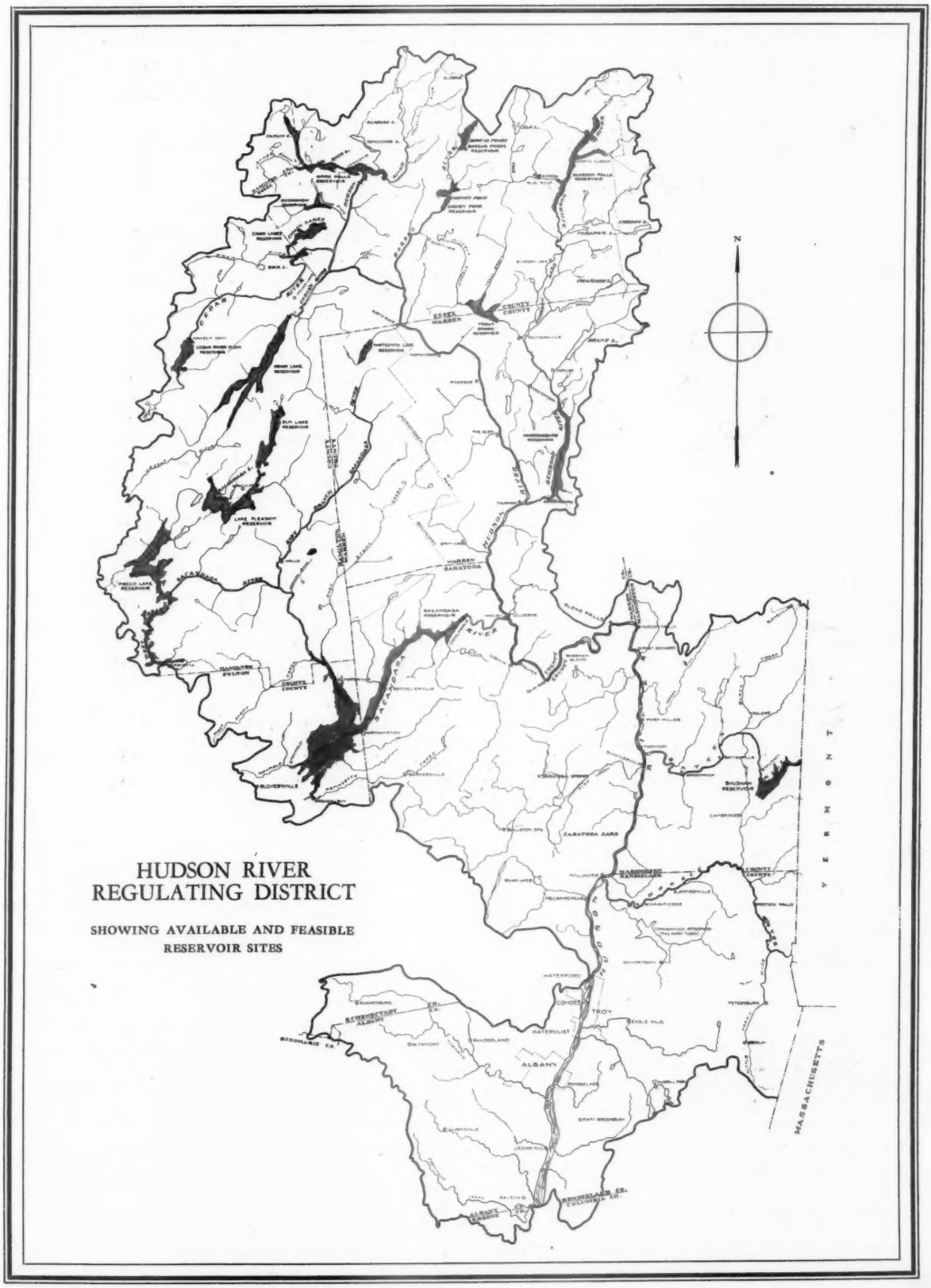
TYPICAL SECTION OF EARTH DAM

Maximum Height 96 Feet
Top Width 40 Feet
Upstream Slopes: 1 on 4, 1 on 3.5, 1 on 3
Downstream Slopes: 1 on 1.5, 1 on 2, 1 on 2.25, 1 on 2.5

CROSS SECTION SHOWING CONSTRUCTION OF DAM



TYPICAL SECTION OF SPILLWAY CHANNEL


HUDSON RIVER
REGULATING DISTRICT
SHOWING AVAILABLE AND FEASIBLE
RESERVOIR SITES
N
VERMONT
MASSACHUSETTS
ALBANY
TROY
SARATOGA LAKE
SCHENECTADY
WARREN
SARATOGA
HAMILTON
FULTON
COHOES
WATERVLIET
WATERFORD
GREENBUSH
RENSSELAER CO.
COLUMBIA CO.

DISTRIBUTION OF INCOME IN INSTALMENT FINANCE

A Mathematician Solves a Problem for Wall Street

By Otto C. Lorenz

DURING the last decade the invasion of business by the scientifically trained mind has been an invincible march. Everywhere can be noted signs of the conquest; there is a diligent searching for fundamentals, a thorough-going attempt to refine and improve today's practice, a successful striving for efficiency of operation, economy of material, and elimination of risks. An excellent example of the value of the scientific approach can be found in the field of instalment sales and finance, a field which in the last few years has become of major importance in the world's business. The work of the mathematician in reducing the number of indeterminate factors in instalment sales and finance has already gained considerable headway and some of this work has been described in an elementary way in various magazine articles by the present writer.[1] In this paper it is proposed to go a step further in demonstrating what mathematics can contribute to banking, and in particular to instalment finance.

There are innumerable ways in which the profit on an instalment transaction may be distributed over each instalment. Let us assume that we have a series of 12 instalment notes of $100 each due at monthly intervals. Let us assume that a finance company is willing to purchase these notes from us for $1,000. If we assume that all 12 instalments are paid in full when due, then the finance company's profit on the transaction is clearly $200. But it is also perfectly obvious that the finance company can not "count its chickens before they are hatched," — it can not be sure that its investment or principal will be repaid, not to mention its profit, until each and every instalment has been paid up. Then how much principal and how much profit is to be contained in each instalment? It is precisely at this point that an amazing array of systems are presented for distributing the profit and incidentally the principal of such instalment transactions. A discussion of the merits and demerits of all of these systems would require more space than the limits of this article permit. We can present only those systems which are in general use at present or which have been advocated by leaders on the subject and discuss their relation to certain fundamental concepts which underlie the entire scheme of affairs.

A system which may well be regarded as primitive and which has become practically extinct in this country, though it is still in use by certain European instalment finance companies, is here presented for the sake of contrast. This system does not spread the profit at all, but permits the total income on a certain transaction to be written down as profit at the time of making the deal. Thus the books of the company employing this system do not reveal the fact that part or all of the amounts written down as profit may actually develop into a loss as time progresses and the instalment transactions upon which the profits have been calculated fail to pay out.

To correct this misleading statement of the company's position, the accountant evolved a system of distributing a portion of the total profit contained in an instalment transaction into each instalment of the transaction so that each instalment consisted partly of profit and partly of principal. As time progressed and instalments were paid, the amounts of profit contained in the paid instalments were regarded as *earned income* and the amounts of profit contained in the unpaid instalments were termed *unearned income*. The sum of the earned income and the unearned income on a particular transaction were, of course, equal to the total profit, or *gross income*, on that transaction.

The first system to be advocated by the accountant was that of prorating the amount of profit over each instalment. If the instalments were equal, then each instalment would contain an equal share of the total profit on the transaction. Thus an instalment transaction consisting of 12 payments of $100 each, which amounts included a total profit of $120, would be regarded as an instalment transaction, each instalment of which would contain $90 of principal and $10 of profit. As payments were made, $10 of each payment would be allocated to earned income, $90 to repayment of principal, and the unpaid instalments would consist of unearned income and principal (or capital) outstanding in the same ratio. This method was easily introduced and its applications fairly understood by the employees of instalment finance companies throughout this country. It is in general use today and has been accepted, moreover, by the Federal Government of the United States.[2] This distribution gave rise to a series of capital turnover factors which have been described in some detail in another article.[3]

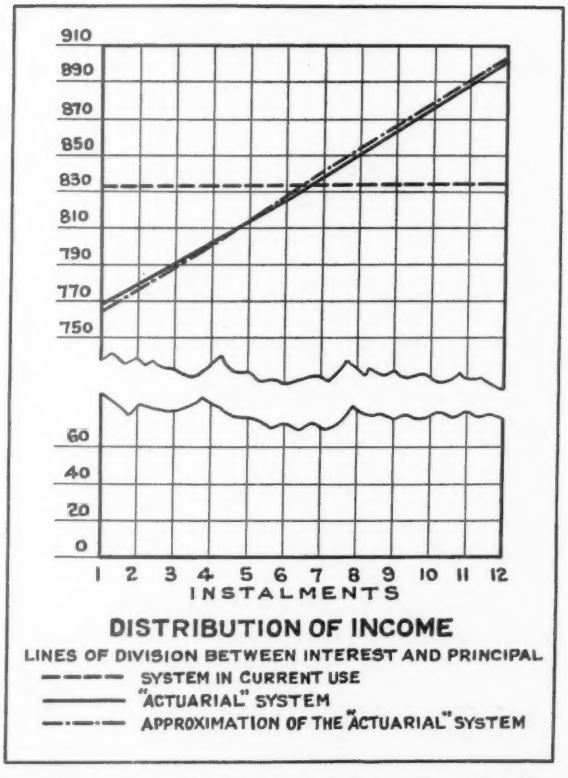
In the minds of a few of the leading accountants and mathematicians of this country there seemed, however, to be a discrepancy in this distribution of income. After all, a finance company is engaged in the business of lending money and its profit may in a sense be regarded as an interest charge for the use of that money. Systems were therefore developed in which this concept was recognized.[4] The profit, or interest, on an instalment transaction was now adjusted from instalment to instalment so that the amount of interest (or profit) contained in an instalment was based on the interval of time between each successive instalment and the amount of principal outstanding during that interval of time. Comparing this method with the foregoing method, it is to be noted that the earned income of this method is greater than that of

the foregoing method during the earlier months of the instalment transaction, whereas it is less in the later months. The total amount of each instalment, made up of interest and principal, is, of course, identical for one system or the other. This system, sometimes termed the actuarial system, involves a geometrical progression and renders it formidable to the employee of the instalment finance company unless he is taught the use of tables which govern this procedure. An approximation of this system has been developed which, nevertheless, remains about as formidable to the employee as the actuarial system, but which presents a possible advantage in that it uses an interest rate with which the employee is familiar.[5] In order that the reader may visualize the distribution of income under the currently employed system, the actuarial system, and the approximation of the actuarial system, the accompanying chart is presented for a transaction consisting of 12 instalments of $916.67 each, the total profit of the transaction being $1,000 and the total amount of the transaction $11,000. In the chart the space below each point of the curve represents the amount of principal in the transaction whereas the space above represents the amount of profit. In each case the total amount of principal for each system is $10,000 and the total profits are $1,000, the curves being distinguished only by their method of distribution of the income and the principal over the several instalments.

One other refinement of the actuarial system should be mentioned in passing. The mathematician will note that the finance company's volume of transactions is (supposedly) continuous. In other words, the total volume of business which may be transacted over any month should be treated on the basis of a certain daily or hourly volume of business and the distribution of earnings over the period of the company's activity may then be adjusted with this consideration in mind.

HAVING thus briefly described those systems of distribution of income most worthy of note we may devote our attention for a moment to items of expense and endeavor to determine whether these items may be classified in such a way as to bear some more or less constant ratio to these elements or factors which are employed in the distribution of income.

An expense item of major importance in the activity of an instalment finance company is that of cost of money in the shape of borrowed funds. It is perfectly normal for a finance company to borrow from two to four times the amount of its capital, or net worth, and employ these borrowed funds for the purchase of instalment "paper." The bank as a rule charges the finance company for the use of these funds at per annum rates on the amount and the outstanding time of the obligation. Evidently, if cost of loans were the only items of expense to be considered, a system of distribution of income such as the actuarial one would be more closely correlated with the expenses of the company, and might be said to give a fairer representation of its earning power, inasmuch as the actuarial system is equivalent to assuming that it costs so much per month of each dollar of outstanding volume based on the advances (purchases) made by the finance company, i.e., the total outstanding capital of the finance company.



THE HEIGHT ABOVE EACH POINT IN EACH CURVE REPRESENTS THE PROFIT OR INTEREST FOR THE PARTICULAR SYSTEM REPRESENTED BY THE CURVE. THE DISTANCE FROM THESE POINTS TO THE BASE OF THE CHART REPRESENTS PRINCIPAL

But cost of borrowed funds are not the only items of expense. It is possible for many other items such as cost of bookkeeping, collection, salaries, and so on, to be expressed as percentages of the volume of transactions rather than the amount of capital outstanding upon which the actuarial system of distributing income is based. Hence, a distribution of income which is in line with such expenses might be advocated as more accurately describing the income or earning power of the instalment finance company.

AT THIS point it will be interesting to introduce the Equation of Stability, which my colleague, Mr. Mott-Smith, first developed in connection with the problem of the automobile dealer. This equation is of extraordinary interest and importance and, in so far as we are aware, presents a fundamental, new development in the subject of instalment sales and finance.

For the case where all the capital is invested in the first month, the equation of stability for the automobile dealer is as follows:

$$\frac{B+\beta_1-\epsilon}{W}\left(\frac{C-E}{C}\right)+\frac{\gamma_1+\beta_2}{W}\left(\frac{C-E}{C}\right)^2+\frac{\gamma_2+\beta_3}{W}\left(\frac{C-E}{C}\right)^3 + \ldots + \frac{\gamma_n+\beta_{n+1}}{W}\left(\frac{C-E}{C}\right)^{n+1}-1\geqq 0$$

Here C is the amount of capital (*Continued on page 107*)

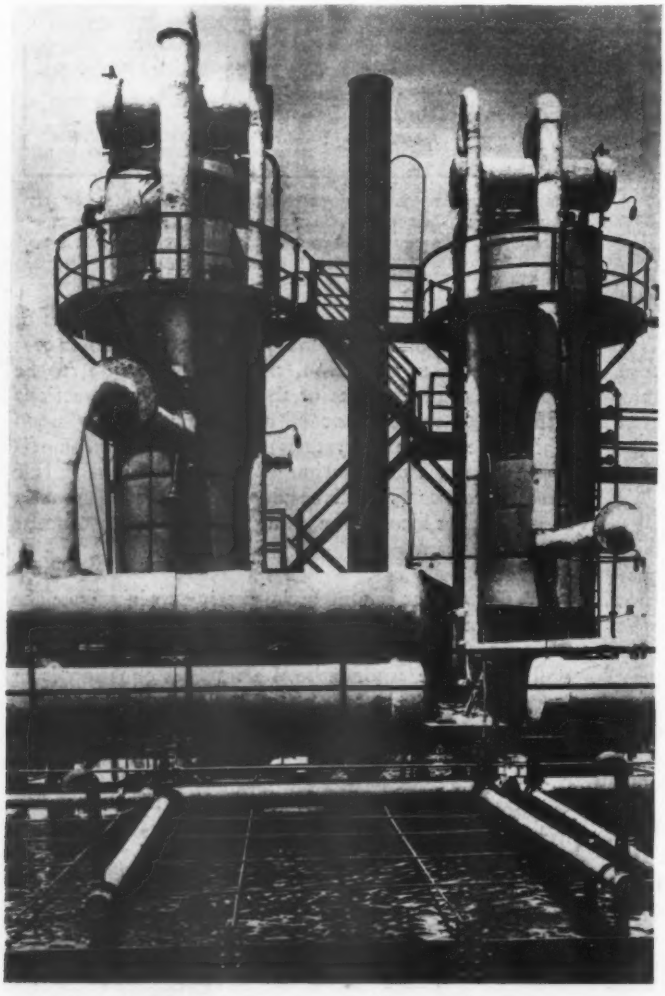
INDUSTRY AND ENGINEERING SOVIET

Part II—The

Memoranda By An

Moscow, February 28, 1930

ON FEBRUARY 14, I noted (See the October Review) a much discussed rumor of a wholesale invitation, which in some quarters was interpreted as a command, to Russian engineers to join the Communist party. This rumor was of so radical a nature that I tried to run it down, and have learned that there has been at no time a "wholesale invitation" to engineers to join the Party. The impression originated with two important addresses delivered about a month ago: one by Koubisheff, President of the Supreme Economic Council, at Leningrad; the other by Rykoff, President of the Council of National Commissars, at Moscow, before the local engineering societies. Both speakers dwelt upon the great responsibilities placed upon the engineers, and the important part they have played, and will continue to play, in the economic and industrial development of the country. They referred to the sabotage and opposition that had been discovered repeatedly in the higher circles, which so far had failed to become reconciled to the new régime. They cited numerous instances where engineers of high standing had deliberately abused the confidence placed in them by crippling industries and embarrassing the government's plans for industrial development. Both speakers made an impassioned appeal to all engineers, whatever their political views, to carry out in good faith and in accord with the general policy laid down by the Supreme Economic Council, the tasks entrusted to them and the duties assumed by them. This places an entirely different construction on the so-called news, since it was an appeal for coöperation rather than an invitation to join the party ranks.



GRAVER SYSTEM OIL REFINERY, BUILT BY "AZNEFT," SOVIET OIL TRUST

In the 40-page pamphlet by the well-known economist, Krijanovski, entitled "Sabotage as it Exists," are given numerous extracts of depositions and trial records of engineers accused of sabotage during the past few years. The author states that during the last two years sabotage as well as counter-revolutionary organizations have been discovered in the ranks of prominent engineers, and that their wide activities and their manifest political aims could not have failed to attract the watchful attention of the government. He attributes the sabotage in engineering circles to their irreconcilable attitude toward the present régime, and traces the origin of their activities from the beginning of the civil war of 1918, with the constant strife between them and the existing government. He cites cases where these engineers, who were responsible for the management of important industries, were in close touch with the former owners of the properties, Russian emigrés and foreigners residing in Western Europe.

Whether this is true or not, it explains why in every large engineering project a member of the Party is stationed as a watch dog to guarantee that the enterprise shall be carried out to the best interests of the country. It would be unfair to accuse all engineers of sabotage, but under

IN THE UNION OF SOCIALIST REPUBLICS

Five Year Program

AMERICAN ENGINEER

present conditions in Russia the innocent and the guilty suffer alike, and the trusted members of the Party who are placed over the executive engineering staffs prove only too often, because of their ignorance of the enterprise over which they are in nominal command, a great obstacle to their rapid progress and their satisfactory consummation. Undoubtedly some of the leading government officials realize this handicap, but with them it may be a choice of the lesser of two evils.

The universities are beginning to graduate young engineers, who, having grown up with the present régime, are loyal to it, but because of their inexperience and their distrust of the older and abler engineers cause considerable friction, and so unwittingly prove handicaps to the more rapid and efficient industrialization of the country. I have met a good many of the engineers of the old order, and have not seen the slightest indication of their not giving their best to their jobs. In this the government faces a serious problem, which it tries to solve by inviting foreign engineers and technicians to help them in their big undertakings. I am told that there are almost a thousand American experts alone now engaged in Russia in an advisory capacity. The problem is to select men of sufficient ability to be of real service to them, but because of their limited foreign exchange they are too frequently governed in their selections by the compensation involved rather than by the competence of the individual.

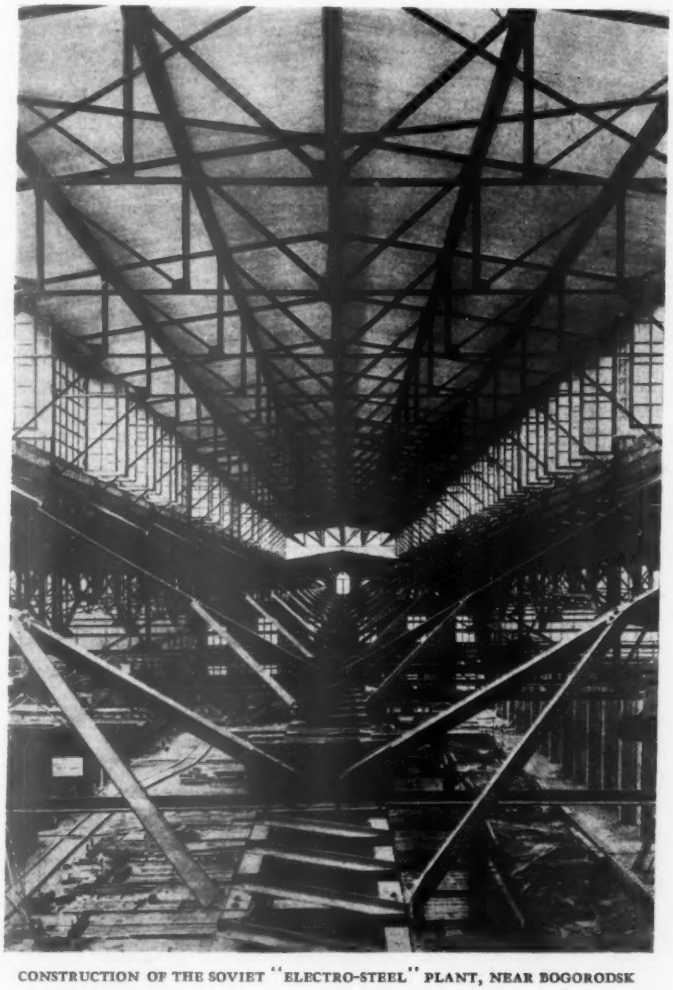
Moscow, March 4, 1930

Day before yesterday a message from Stalin, intended for the widest possible distribution, was published in all the papers under the caption "Heads Turned by Success." It referred to the great progress that has been made so far in the collectivization of the farms, and warned the Party not to lose its head, and not to press collectivization too far, since the movement can be a success only with the voluntary co-operation of the farmers. He stated that fully 50% of all the farms had already been formed into collectives and that in many regions the farmers are not yet ready for this movement, and should be left alone.

Some people have interpreted this as a swing of the Party to the Right, but Duranty does not think so, and I am inclined to agree with him. It seems to me that having succeeded so quickly in bringing 50% of the farms into collectives — which Stalin claims is twice the number they had hoped for — the Party prefers to consolidate its gains and call off all strong arm methods.

I saw my first Red funeral yesterday, probably a member of the Supreme Economic Council who died a day or two ago. The coffin and the hearse were a flaming red, and were covered with flowers. Four people preceded, carrying large wreaths with inscriptions, and following the cortège was a band of music and some 50 people. All bodies are cremated.

New American faces show up every day, mostly engineers engaged by the government. Most of the foreign engineers and experts on their arrival here are



CONSTRUCTION OF THE SOVIET "ELECTRO-STEEL" PLANT, NEAR BOGORODSK

extended a very cordial invitation by the Chamber of Commerce of the U. S. S. R. to address it on the subject on which they happen to be most expert. This Chamber of Commerce has organized various sections such as the American-Russian section; the German-Russian section; the British-Russian section, and so on. Its headquarters are in the former sumptuous Stock Exchange Building. I dodged an invitation last winter, but did not succeed in doing so this year and so about a week ago I talked before the American-Russian Section of the Chamber of Commerce of the U. S. S. R. on some recent phases of American railway development. At the end of my 40 minutes' talk, which was given in the evening, there was a recess during which refreshments were served and afterward, as is usually the custom, I was asked numerous questions of a character and variety that tax one's fund of information.

March 20, 1930

Another step in the direction of rational industrial management is the order recently put into effect giving managers full authority, *yedinonachalie* (single management) the Russians call it. Heretofore, everything has been managed by a committee. The Workmen and Soldiers Committee was the supreme authority during the first months of the Revolution, but was too unwieldy and had to give way to a responsible dictatorship centered in a few men.

Industry was likewise managed by committees of working men, who could depose the responsible chiefs and generally impair their authority and efficiency, and consequently through all these years of struggle and development there was a constant conflict between the nominal managers and the workmen's committees. The "wall papers" (bulletins and posters) about which I wrote you last year, and which were in evidence in every commercial, banking, and industrial institution, were the means employed by the committees to criticize or condemn the management. So long as the criticism was fair, and of a constructive nature, the "wall paper" served a useful purpose; but it could not long be maintained at that level and soon developed into a vindictive and destructive force which gradually began to undermine the organizations. The cartoons with their bitter gibes and open accusations posted on the main stairway of the State Bank Building, where everyone stopped to read, could not fail to weaken the people's confidence in the men who were in charge of the country's great financial institution, however little foundation there might be in the criticisms themselves. Human nature is much the same all the world over, and the petty jealousies, prejudices, and bitter recriminations, which have hampered the Russian leaders so seriously, remind one of the obstacles placed in the path of the early American patriots who, with perhaps no greater zeal, were struggling for a new political ideal. All too often, I am told, because of this suspicious attitude, have men of real ability and earnestness been removed from important posts by employees' committees or by party members at the annual "purging" meetings. Unfortunately these "wall paper" attacks and party "purgings" most frequently are aimed at men of independence of thought and action, merely because they happen to belong to the intellectual or the formerly well-to-do-classes.

No matter how one may feel about the theories and experiments of this group of men, it is impossible not to admire their speed and thoroughness of retraction, when once they see that they have been wrong. And so in this matter, almost overnight they have changed from what might be called multi-management to an extreme form of autocratic management, which I should not be surprised to see them carry much farther in their industrial management than would be permitted by our own labor unions.

April 24, 1930

Last year while I was here the great topic of discussion everywhere was the now well-known Five Year Plan. This plan provided two alternatives with a minimum and a maximum budget, ranging from 27 to 32 billion dollars for the five-year period. After weeks of discussion the maximum budget was adopted, and on May 1 ratified by the Fifth Congress of the Soviets. Industrial and railway expansion were emphasized, although provision was made for agricultural expansion and farm aid.

This huge budget appeared fantastic, and many rightly questioned the possibility of carrying it out. Especially abroad was the prediction freely made that it would remain a paper plan, a hope unrealized. The results of the first year of operation have far exceeded the fondest hopes of the sponsors. Actual production in industry increased over the previous year by 23.7% as against the 21.4% set as the goal of attainment. Capacity of electric power stations increased by 20.3% as against the 14% indicated; gross freight handled by the railways increased by 21% instead of the estimated 10.1%. Similar results obtained in other branches of the national economy have led to their advocating that the five-year program be carried out in four years. During the first few months of the present fiscal year this higher goal has not been attained, but under the spur of necessity to meet a constantly growing and urgent demand for manufactures and products of all kinds the operation of plants is being speeded up, and with reasonable assurance of success.

In this Five Year Plan agricultural improvement and expansion were given their proper place, but it was not until this winter that the plans then contemplated were matured and the machinery set in full motion for their ultimate fulfillment. Ever since my arrival in Moscow, on January 23, the newspapers have had almost daily articles on the agricultural problem and its solution, which is collective farming. The peasant and his land have been a problem in Russia for centuries. Alexander II attempted a solution in 1861, when the serfs were partially liberated. The Russian peasant's hunger for land was not satisfied, however, and it was the clever slogan "Peace and Land," and the promise to divide the land among all the peasants, that enabled Lenin and his party to gain control of the government during the October Revolution, and the large estates were actually divided among the peasants who had formerly worked on them. To insure an equitable division, these estates were divided into small parcels of land of various grades, and as a result many farmers had their several parcels of land at considerable distances apart. Each small strip of land was separated from its neighbor by a ditch, and it is estimated that there were 27 million such little farms. *(Continued on page 104)*

The City Beautiful Becomes the City Vital

LOWER NEW HAMPSHIRE AVENUE WITH ITS ARCHING ELMS AND STATELY HOMES. WHAT IS THE STORY OF THE ENGINEERING BEHIND IT?

THE WASHINGTON NOBODY KNOWS

By George A. Ricker

THAT Washington occupies a place high up in the list of the world's most beautiful cities is a fact well known to all Americans; that it has also attained an enviable position by virtue of its achievements in city engineering and city planning is a fact not so well known or understood. The city beautiful has become the city useful; its population of a half million or more is no longer expected to exist on beauty alone. In this era of unregulated city growth with its concomitant evils of noise, congestion, and stench, Washington is emerging as the antithesis of all of this — a livable, healthy, useful city.

When in 1791 Major Pierre C. L'Enfant's Washington included only nine and one-half of the District's 100 square miles and his plan covered thousands of unoccupied acres, the problems of sanitation and communication were comparatively simple. President John Adams could bathe in the waters of the Potomac in the back yard of the White House and southern congressmen guided their mounts between ash heaps and around mud holes on Pennsylvania Avenue to the Capitol.

After "Boss Shepherd" took the town by the nape-of-the-neck and shook it down for a few millions of needed improvements, it was a much healthier place to live in and had what every well-regulated town today has — a good-sized mortgage to pay off. The town soon outgrew its L'Enfant clothes and stretched its legs and arms out into the lovely hills and vales of the District. Unguided, misguided, it grew, for the time being misshapen and disorderly until sheer necessity brought forth the McMillan plan of rearrangement in 1901. As so often occurs, the *plan* seems to have allayed discontent and nothing much happened to put it into effect. Many years passed and the big, overgrown village, the stepchild of Congress, needing its streets straightened, connected and paved, its sewers enlarged and lengthened, a new water supply, more parks and bathing facilities, found itself all at once the capital of a world at war.

Thousands on thousands of patriotic young men and women and "dollar-a-year" men came and camped out. It was an era of five or six girls in a room, cooking their own meals on a small stove in the basement, boys bunked in two and three-storied cots and grub staking themselves at chain store groceries with food at war prices and "no meat" and "no heat" days every week, and then the flu. Who can forget it? Two or three of the five girls in the one room were gone in a day or two; the boys, mostly those winnowed out of the draft as unfit for military service, fell one by one. All that our own devoted women of the great Red Cross could do did not alleviate conditions much, and the slaughter "behind the lines" right in the world capital went on until the dread malady spent itself with an appalling death toll.

It is not pleasant to think about, but it helped to awaken the people of Washington and Congress to the physical needs of the overgrown village that had so quickly become a great city. Full speed ahead was ordered, temporary housing was provided, and civil and military authorities coöperated to improve sanitary conditions. And just as some order was evolving from the chaos of neglect, Armistice Day came, the pressure of great necessity was withdrawn, and the camp began to demobilize.

Held by the charm of Washington, many of its war workers stayed, adding materially to its permanent population. Temporary governmental control and regulation of business instituted under war conditions was to some extent made permanent, and commissions and

Fairchild Aerial Survey, Inc.

ARLINGTON BRIDGE ACROSS THE POTOMAC, CONNECTING LINCOLN MEMORIAL WITH ARLINGTON CEMETERY, 1,858 FEET LONG AND ONE OF THE WORLD'S FINEST EXAMPLES OF STONE ARCH SPANS. ANOTHER OF AMERICA'S GREAT MASONRY BRIDGES, THE CABIN JOHN, IS NEAR WASHINGTON

departments, created hurriedly, were reorganized and housed for peace time service in the temporary buildings erected, for the most part, on park lands.

Measures and methods in effect to care for the health of the people in the war growth had now to be reconsidered and made operative for a greatly increased permanent population and an enlarged business community. Public utilities, which before the war had reached their maximum of usefulness, demanded immediate extension and enlargement. The overgrown village had become in two short, hectic years a great throbbing center with new hopes and ambitions, and the people demanded physical and spiritual improvements commensurate with their new life. Above all, the health-giving and health-insuring utilities which had been overworked had to be immediately enlarged to meet the new needs.

Realization that Washington needed more and better parks led to the creation, in 1924, of the National Capital Park and Planning Commission which two years later was given power to acquire additional lands and was charged with the duty of supervising the McMillan highway plan of the District and the preparation of a complete and coördinated plan of the Nation's Capital and the region surrounding it through coöperation with the adjoining states of Maryland and Virginia. A sub-committee of the Commission known as the "Coördinating Committee" made up of district and federal officers and a representative of organized citizenship devoted itself to the modification of the highway plan to provide better traffic facilities and adjustment of the street system to natural topography and park boundaries.

Colonel U. S. Grant, 3d, in describing the work of the commission for the suitable and proper development of the city's facilities says, "The natural advantages of the site and location selected by the President to whom it is a living memorial are such that to the utilitarian features may be added, at relatively reasonable cost, the embellishment which, with the preservation and suitable development of its natural beauties, will make it 'express the soul of America' and when viewed by an American citizen will arouse his imagination and stir his patriotic pride."

For 75 years, after Major L'Enfant conceived his plan in 1791, the city, beyond the nine and one-half square miles encompassed by Boundary Street (now Florida Avenue) was without a plan. Without reference to the original plan, property owners in this new area gaily subdivided, ran lot lines, cut grades and otherwise carried on in a manner which inevitably resulted in a patchwork puzzle of property, wholly out of relation to anything else in the District. The street plan developed

Kaufmann & Fabry

THROUGH THIS TUNNEL OR CONDUIT, SHOWN HERE UNDER CONSTRUCTION, THERE CAN FLOW INTO THE CAPITAL 100,000,000 GALLONS OF WATER EACH 24 HOURS. THE OLD CONDUIT, WHICH IS UNDER THE ROADWAY AT THE LEFT OF THE PICTURE, HAS A DAILY CAPACITY OF 82,000,000 GALLONS. DELCARLIA RESERVOIR, A PICTURESQUE NATURAL BASIN AT THE DISTRICT LINE, RECEIVES THE FLOW OF BOTH AQUEDUCTS

was so out of joint with actual city requirements that Congress in 1893 ordered the preparation of a highway plan which would govern the remainder of the District. The L'Enfant gridiron and superimposed plan of diagonal streets was then extended out over the entire territory.

Power to change further the existing plan has been vested in the Planning Commission, carrying with it also power to regulate street area dedication and condemnation. This authority has been exercised to bring about desired changes in topography, drainage conditions, or street and park boundaries. Many additional changes in existing terrain will be required before the major street plan for the district is carried out to a successful conclusion. By virtue of the plan of 1901, the Lincoln Memorial, Union Station, and Arlington Bridge projects have been brought into successful and harmonious relationship with other elements of structural Washington. The Mall, Lafayette Square, and the Triangle are other units of the general scheme which in time will testify further to the excellence of the 1901 idea.

The avenues of the L'Enfant plan bearing the names of the states have now been extended beyond the limits of the original city, in some cases all the way across the District to the Maryland line, making connection with the main roads of that state and thereby affording ready entrance and exit to and from the center of the District for the thousands of tourists who from East, North, and West must cross Maryland to reach the National Capital. Straightening and widening these thoroughfares has greatly facilitated the constantly increasing volume of traffic.

A notable case in point is Rhode Island Avenue, which by agreement with "The Old Line State" has now been projected to the eastward to provide for more direct connection with U. S. Route No. 1, over which thousands of cars pass daily between north and south. Another important extension now in process of development is that of Sixteenth Street which leads directly north from the White House and Lafayette Square in the center of which is located the extraordinary statue of General Jackson mounted on a prancing steed with curly mane and tail. Where Sixteenth Street crosses the District line into Maryland it is planned to build a beautiful gateway with a triumphal arch or other suitable form of memorial.

In the old city, now downtown Washington, many of the "gridiron" streets devoted entirely to business have had their roadways widened from 30 or 40 feet to 60 and 80 feet. This, accomplished by borrowing sidewalk space which was often 25 or 30 feet in width, was done against the noisy protests of older Washingtonians who were grieved at the removal of many trees that had been planted and nurtured since the village days. The extraordinary growth of the capital in the decade has made necessary such drastic surgical operations to meet the demands for business and to relieve traffic congestion. To the everlasting credit of the Federal and District governments immediate replacement of the trees has been made and, wherever possible, trees of a finer and sturdier character were planted, and are being carefully guarded and cared for by the District Forester.

In the decade the District has made rapid strides in the matter of securing more and better pavements. On June 30, 1919, the records show that there were in round numbers 7,352,000 square yards of street pavements of different classifications. On the same date in June, 1929, the record was 8,606,000 square yards, a net increase of over one million and a quarter yards, or 17.1%.

In order of precedence for yardage built during this 10-year period in excess of existing yardage, sheet asphalt on concrete shows a growth of 11.8%; cement concrete an increase of 775%, and macadam a decrease of 29.2%. The astonishing record made by the concrete type is due to the fact that practically all streets previously unpaved were improved with this material in the decade and most of the decrease in macadam was due to replacement with more permanent pavements.

It has long been the rule, by custom and law, that streets in the District, once paved, shall be renewed with the same material; in those streets in which in the early days macadam had proved adequate, automobile traffic of later years demanded a more substantial type. In street widenings the added width of pavement has been of the same type as the old. In the extension of main thoroughfares through new territory the new pavement has been almost invariably of cement concrete. Of the 619 miles of streets now improved 369 miles are of asphalt, concrete, or macadam, 67 miles are of various kinds of blocks and other miscellaneous types, and 183 miles temporarily maintained with gravel surfaces.

THE parks of the District have been skillfully developed in widely separated areas, utilizing picturesque Rock Creek and its branches, and other sections almost too rugged for domestic uses with results altogether charming, but it yet remains to connect these beauty spots by parkways passing through the changing scenes of frowning cliffs and rolling lowlands to tidewater levels at Hains Point and the yacht harbor. Rock Creek drive, soon to be completed, will pass under the so-called million-dollar bridge on Connecticut Avenue and into Potomac Park at the great circle about the Lincoln Memorial and the water gate now being built at the northern end of the Arlington Memorial Bridge.

The complete union of North and South, accomplished in the minds and hearts of the people in the half century which has elapsed since the war between the states, is about to be sealed by the completion of a permanent bridge spanning the Potomac and re-uniting with bonds of stone and steel the lands that were for a brief period separated by this noble river.

The McMillan plan stressed the importance of Water Street as a connecting link in the boulevard system between Potomac Park, the War College, and Anacostia Park. Present plans of the corps of engineers contemplate the building of a bridge across the waterway connecting the tidal basin with the Washington channel which will provide a driveway joining the so-called speedway around Hains Point with Water Street.

It is entirely feasible to combine commercial and boulevard features in Water Street, which borders the Washington channel for about a mile between the tidal basin and Washington barracks. The principal activities of this water front are the lines of steamers to Norfolk and to points on Chesapeake Bay and the lower Potomac. The harbor police station and the District fire department steamers are located here. The *(Concluded on page 94)*

THE TREND OF AFFAIRS

Exit Shale Oil

CHARGES by Ralph S. Kelley of the Department of the Interior that the government's shale oil reserves in Colorado are not being properly conserved raise the question of the value of shale as a source of petroleum. The United States, without its shale reserves, already has petroleum far in excess of its needs, and the constant discovery of new wells by the methods of geophysics assures a supply for many years to come.

With oil wells, therefore, everywhere being held in leash by a national curtailment program resulting from overproduction, the commercial production of oil from shale becomes, so far as the United States is concerned, a dream of the future, a fantasy of the present. The oil requirements of the United States are approximately 2,600,000 barrels a day; the available supply from potential sources is several times this figure. In one field alone, the famous Yates Pool of Texas, it has been shown by opening the wells for one hour a month that from this vast reservoir oil would rush at the rate of 4,000,000 barrels a day. The actual production from this field under the curtailment program is held down to 105,000 barrels daily.

United States Rubber Company

MILKY LATEX AS IT DRIPS FROM THE RUBBER TREE. AFTER A PRESERVATIVE IS ADDED IT IS SHIPPED IN LIQUID FORM

The hydrogenation process of oil refining now being exploited makes possible a tremendous increase in yield, and at once interjects a new factor of economy into production. In fact, the belief has been voiced that hydrogenation will be applied to the production of oil from coal long before it is found desirable to develop the shale oil deposits.

Granted that more efficient methods for producing oil from shale are possible, another serious obstacle stands in the way of commercial utilization of these reserves. In processing the oil shale, the material is crushed and then subjected to great heat in retorts from which the gases are led to condensing machinery. Here lies the great problem, for water is precious in regions where oil shale is found, and unlimited quantities of cold water are vital to economical production.

Oil, as such, is found in very few of the so-called oil shales. The substance from which the oil is produced is kerogen, bituminous matter from which oil is produced by chemical change. The generally accepted theory has been that oil bearing shale was the source of the present petroleum pools and that the existing shale represents deposits from which the oil has not yet been discharged, The oil yield from shale varies according to the locality, from a fraction of a barrel, to several barrels of oil to the ton.

It is estimated that nearly 400,000,000,000 tons of oil bearing shale are available in the United States. It is found in an area of 86,000 acres in Colorado, 2,696,000 acres in Utah, and 460,500 acres in Wyoming. Only a small part of this area lies in the naval oil reserve. As for the petroleum reserves which have been developed by the government, the Elk Hill, Calif., field is estimated to contain 600,000,000 barrels. Reserve Number 2, at Buenavista, Calif., has a possible production of more than 100,000,000 barrels, and the famous Teapot Dome Reserve, which is Number 3, holds some 20,000,000 barrels. A fourth undeveloped reserve lies in Alaska.

With these being held for the future and with the probability that still other sources of oil will be discovered, it seems reasonably certain that the nation's oil shale fields will long remain the home of the coyote and the cactus.

Rubber Milk

HALF way around the globe from Akron, Ohio, lie the lush, exotic lands of the Middle East — the Malay Peninsula, Burma, Java, Sumatra, Borneo, Indo-China, Ceylon. Here in the rubber isothermal zone, teeming with the world's cheapest labor, 7,000,000 acres of rubber trees are cultivated. These trees, yielding a milk-like fluid called latex, originated in Brazil as a result of a stupendous exchange in the world's agronomy. About 1875 coffee trees in India and Ceylon were ravished by bugs, and rubber trees in Brazil were neglected by an indifferent people. Brazil had no coffee bugs and Ceylon no rubber trees, so Sir Henry Wickham, under the auspices of the Royal Botanical Gardens, Kew, England, violating laws and outwitting nature, transferred seedlings of the *Hewa braziliensis* to Ceylon. They flourished there, and thus Brazil lost its supremacy in rubber to the Middle East just as it gained supremacy in coffee.

Blackington

NOT OSCILLOGRAPH CURVES, BUT THE SPIRAL COURSES OF CLIMBING ROCKETS OVER THE INSTITUTE'S DOME

Labor conditions and climate make it necessary that rubber be produced 12,000 miles from its principal point of consumption, but labor and climate have not dictated the form in which it shall be shipped. For years, rubber latex, coming from the trees drop by drop, has been gathered by natives and then coagulated; that is, the 30% or more of solid matter is separated from the milk-like liquid and dried, forming crude rubber. This crude rubber in the form of "hams," sheets, or crêpe is then shipped to Akron and other manufacturing points. But why not ship the rubber milk in its easily handled liquid form?

Because of its similarity in another way to cow's milk: it spoils quickly and for years no way could be found to preserve it — not, at least, until some minor Pasteur conceived the idea of adding two to five per cent of ammonia to the latex. This solved the problem, for it kept latex in a stable condition for months. The United States Rubber Company took the lead in preserving and shipping latex, and during 1929 more than 10,000 tons were brought into the United States.

The nub of the matter is this, however: latex can be used for a great variety of purposes that crude rubber cannot be. In fact, it is creating new materials, new industries, in a manner comparable to the development of plastics as described in the October Review.

After adding to latices (the plural form of *latex*) materials to modify their color, stability, viscosity, and texture, they are used in preparations such as can-sealing compounds and cloth and leather cements. The Dewey and Almy Chemical Company has two plants in America, two in Italy, and one in Canada utilizing latex for can-sealing. In England a latex paper is being manufactured with unique qualities of strength, water-tightness, and insulation. The latex is mixed in with the paper pulp with the result that the beating necessary is reduced by half, a great advantage in addition to the desirable effects produced in the quality of the final paper.

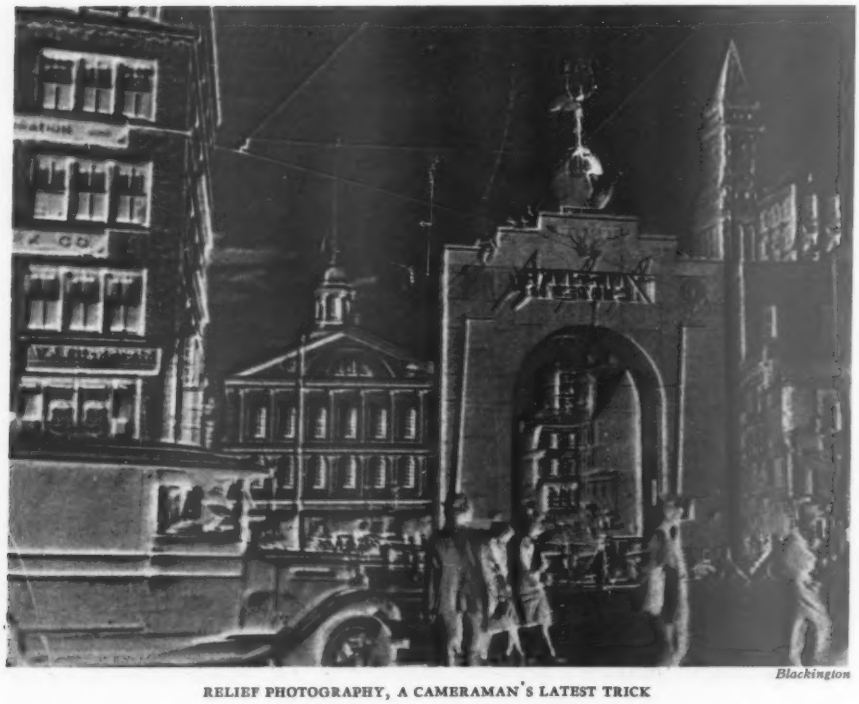
"Ditmarising," a patented process, uses latex to coat the filling materials of mattresses and cushions, increasing their strength and durability and rendering them immune to moths. Latex has been applied as a preservative coating for masonry, for making rugs non-slip on polished floors, in preserving wood, and making pipe joints. Cord tire fabric treated with latex seems to be superior to the rubberized variety, and vulcanized latex is a material of extraordinary strength. Surgeon's gloves made of it are said to resist 15 or more sterilizations. Leather substitutes and artificial lumber containing latex are other achievements with this material. The Dewey and Almy Chemical Company are now manufacturing soles and heels from fiber impregnated with latex, and in addition are producing battery separators and filter mediums utilizing it. Another company is making latex brake lining and clutch facing.

It can be seen readily that the possibilities of latex are enormous; no enterprising industrialist or financier can overlook the advent of the substance. There are difficulties to be overcome, of course, but its advantageous applications are constantly increasing.

It is unfortunate that the early rubber workers were unsuccessful in preserving and shipping latex. Had they been able to send it to America, our rubber industry might be much different. A prominent rubber technologist is authority for the statement that if latex had been available at the beginning of the industry, much of the present-day, cumbersome, and expensive machinery would never have been developed.

United States Rubber Company

CARRYING LATEX FROM TREES TO COLLECTING SHEDS WHERE IT IS COMBINED WITH A PRESERVATIVE



Blackington

RELIEF PHOTOGRAPHY, A CAMERAMAN'S LATEST TRICK

Transplanted Oil

ASIDE from people in the paint and varnish business the mention of tung oil means but little to the ordinary American unless he happens to live near the Gulf of Mexico. Yet it is our fourth largest chemical import today, and because of tung oil the repainting of an automobile, which formerly took as much as six weeks, can now be done and done much better, in as many days. Nearly 60,000 tons of it, valued at $15,000,000 will be brought to the United States this year in tankers from the Orient. But beginning in 1931 the amount imported may be expected to decrease; not that its uses will diminish, but because tung oil is grown rather than mined and because of the faith of the Roosevelt administration, since justified, in the practicability of transplanting *Aleurities cordata*, or tung trees, from China to Florida, a feat fully as difficult as the transplanting of rubber trees.

Known sometimes as China wood oil, tung oil was imported into the United States as early as 1871. Although it had long been used by the Chinese as the basis of their exquisite lacquers, American varnish makers accorded it little attention until about 1900. Like many other things, it owes much of its present-day prominence to the automobile. Foreseeing in 1905 that a domestic source of the oil would be highly preferable to dependence upon remote and erratic foreign growers — the memories of the Boxer Rebellion were still green — an enterprising Department of Agriculture in 1905 set out tung tree seedlings in Florida. Ever since they have been spreading over the Gulf States, for up to now most of the seed has been used for further plantings.

The appetite of a growing automobile industry, the multiplication of tung oil's possible uses in the manufacture of linoleums and oil cloths, enamels, insulating compounds for brake bands, and as a replacement for copal varnish (seriously dependent upon the gum of the diminishing Kauri pine of New Zealand), together with unsettled Asiatic conditions, have constantly encouraged the building up of a domestic source of supply in the 25 years that have passed by since the initial venture in Florida.

In China, the pale yellow or "white tung oil" for export is prepared by roasting the seeds of the tree, then coarsely powdering them, and, after they have cooked, expressing the oil in wooden presses. Chinese tung oil has the highest refractive index of all known fatty oils and, with the exception of castor oil, the highest specific gravity. The readiness with which it becomes polymerized, setting to a hard jelly on being heated for a short time to 250 degrees C., is its characteristic chemical property. Its pronounced rapid drying quality is what renders it highly suitable for use in the manufacture of varnishes to which it imparts a brilliant, hard, and lasting surface.

The trees bear at three years and reach their prime at an age of eight or nine when each yields about four bushels of unshelled nuts, enough to make 30 pounds of oil. Normally, in the United States, 60 trees are planted per acre, the value of the crop being about $200. Tung tree plantings in the coastal districts of Mississippi and Louisiana are soon to be more than doubled from 3,000 acres to 8,000. One company near Wiggins, Miss., is said to have 400,000 nursery tung trees available for expansion of its orchards next January and February. At

Davis

VISCERA OF A CASH REGISTER; A STUDY IN REPEATING DESIGNS

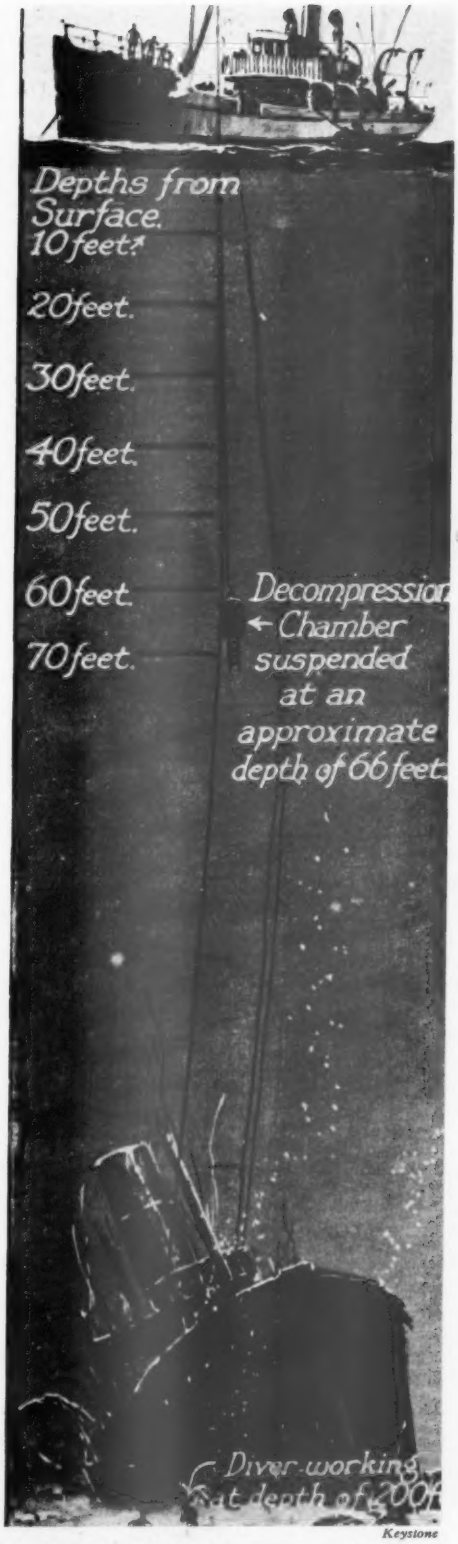
a large plantation in Alachua County, Fla., a crushing plant with an annual capacity of 70,000 pounds of nuts has been placed in operation. So far as is known tung trees are not subject to any disease of insect pests, which is a decided recommendation to farmers who have experienced Mediterranean fruit flies, Japanese bettles, or boll weevils.

Not only has the practicability of growing tung trees in the southern United States been demonstrated, but extraction machinery has been perfected to produce a larger and clearer yield of oil than is obtained by the crude processes still in vogue in China. Scientific care in the cultivation and fertilization of the trees likewise indicates that a domestic oil of a superior sort will become available in increasing quantities to displace the imported product.

The Battle of the Rays

MODERN physics may be said to have begun in 1895 when Professor Wilhelm Konrad Röntgen (1845–1923) accidentally discovered x-rays. In the 35 years that have elapsed, scientists, traveling on the uncharted seas of radiation and radioactivity, have revealed a new world. Explorations into this scientific wilderness have hardly started and every day brings new discoveries. A list of the more understandable ones reported during the past month gives evidence of the fruitful activity that prevails:

1. Using gamma rays emitted by radium, scientists working in the U. S. Naval Research Laboratory have "looked" through steel girders and plates to determine the presence of weaknesses and defects. With a bit of radium hardly larger than the size of a bean, it has been possible to sensitize a photographic plate on the opposite side of a battleship's hull, a feat impossible with generally available x-ray equipment. This gamma light photography, requiring nothing like the cumbersome equipment necessary in x-ray photography, will reveal defects in a metal as small as two per cent of its thickness.



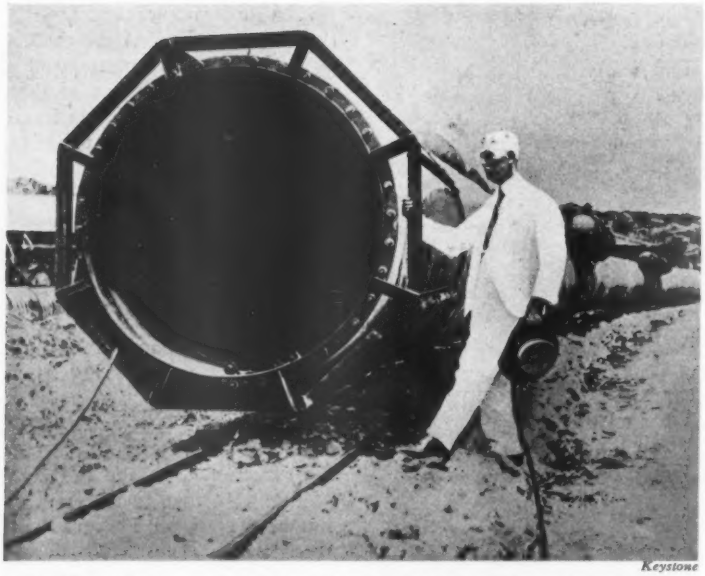
Keystone

DIVING FOR OLD GOLD, UTILIZING A SUBMERGED DECOMPRESSION CHAMBER IN WHICH THE DIVER REJUVENATES ON HIS WAY UP AND DOWN

2. Almost simultaneously with the demonstration of the usefulness of gamma ray photography came the production of a giant x-ray tube at the California Institute of Technology, utilizing 600,000 volts, or more than double the voltage used in present "available x-ray equipment." Giant tubes such as this one may emit rays that have the theraputic value of radium rays, and that will penetrate two inches of lead and two feet of concrete. Gamma-ray photography may not be so superior after all.

3. Professor Robert A. Millikan, working far up in the invisible spectrum from the comparative long wave gamma and x-rays, has been stalking the more elusive cosmic rays. His recent investigations indicate that they are not high speed electrons but ether waves of exceedingly high frequency. If they were electrons, the rays' reception on earth would be influenced by the magnetic polar regions. To test this, Dr. Millikan took the electroscope with which he measures the rays to Churchill, Canada, only 875 miles from the North Magnetic Pole. He made observations every day and night for a week, found the intensity of the waves the same in Churchill as it was in his home in Pasadena, and concluded that cosmic rays bombard the whole earth equally. He also suggested that, since cosmic rays are affected by small changes of density in the air, the cosmic ray electroscope could be used to supplement the barometer in collecting information about the weather.

These three developments in the course of a month represent but a fraction of the discoveries in modern physics that are revealing the unseen activity of the universe. Sir J. H. Jeans, in discussing Millikan's cosmic rays, has speculated thusly on what it all may mean: "In a sense this radiation is the most fundamental physical phenomenon of the whole universe, most regions containing more of it than visible light and heat. Our bodies are traversed by it night and day . . . it breaks up several million atoms



Keystone

GEORGES CLAUDE AND THE MILE-LONG PIPE THROUGH WHICH HE CONDUCTS THE COLD WATER FROM THE BOTTOM OF MATANZAS BAY TO HIS EXPERIMENTAL BOILER-TURBINE. ENGINEERS POINT OUT THAT THE POWER REQUIRED TO PUMP UP THE COLD WATER MAY ALMOST EQUAL THE POWER GENERATED AND THAT THE LOW PRESSURE REQUIRES AN EXCESSIVELY LARGE TURBINE

in each of our bodies every second. It may be essential to our life or it may be killing us."

Neon + Mercury Arc

ALTHOUGH much has been written of the neon light, public knowledge of the use of neon gas for electrical illumination centers around its application to advertising signs, the weird red glow of which catches or repels the eye according to the æsthetic discrimination of the individual.

Recently a young engineer in New York announced the development of a neon lamp which he claimed could be used for general illumination. Description of this lamp included the statement that it can be operated without the use of expensive auxiliary equipment such as transformers and devices to start the gaseous discharge in the neon tube, making it suitable for new uses to which the older type lamps are ill-adapted. As a matter of fact, (it is hoped the young engineer knows it) there are, and have been for several years, a number of neon lamps that can be used on ordinary lighting circuits without the use of transformers.

In what degree the new lamp differs from those already on the market is not of such great concern as is their use for purposes of general illumination. The neon lamp, whose light is characteristically red, has many valuable scientific and industrial uses, but as a source of general illumination, particularly in the home, it is far from satisfactory.

The fact that the neon discharge produces a red light means that the apparent color of nearly everything it illuminates is distorted or changed. Nor is it pleasant to work under such a light, for its red glow is irritating and in some cases causes headache and restlessness.

Laboratory workers, recognizing that the neon light is a step toward the goal of colder light, yet keenly aware of its present disadvantages, have long been working on the problem of finding some method of adapting it for wider use in illumination. The mercury vapor arc light which is blue-green and knows not the red region of the spectrum likewise does not reveal all objects in their true colors. Attempts have been made, but so far without much success, to combine the desirable characteristics of both sources of light in a perfectly satisfactory lamp.

In this age of magnificent accomplishment in research it is unwise to say what cannot be done, but for the moment, at least, the neon lamp is not satisfactory as a source of general illumination. Its industrial uses, however, are far-reaching and very important, for it is the glow of the neon gas in tiny lamps that is playing such an important part in the development of television. A more recent use has been found by those exponents of capital letters, the Motion Picture Engineers, who are now using neon light in combination with that of mercury vapor arcs for new effects in cinematography. The addition of certain quantities of the neon red brings new possibilities for color values on the screen, and no doubt will be used to full advantage in this new field.

River Taming

A SILVER spike, driven to begin a railroad spur from Las Vegas, Nev., to the Colorado River, has initiated construction of the Boulder Dam in Black Canyon — the climax of eight years of negotiations, tectonic probes, and political deviations. Simultaneously comes the announcement that the project is to bear the name of President Hoover who, as Secretary of Commerce, did much to get the project started.

That this Hoover Dam is to be 550 feet high and that it will, with its attendant features, cost about $165,000,000 are facts generally known. A clearer conception of the magnitude of the undertaking can be obtained by these additional statements: there are 7,000,000 acres of land in the Colorado Basin at a proper level with respect to the river to be possible of irrigation; the dam will impound enough water to blanket Massachusetts with a layer five feet deep; as much power as is now used in California or in Illinois, including Chicago, will be generated. The flood control features in themselves are sufficient to intrigue the imagination of the Southwest, for the Imperial Valley has not forgotten the break of 1905 when the Colorado went haywire and revised the Salton Sink into the Salton Sea. Nor does the Southern Pacific fail to recall the $2,000,000 it spent on levees to prevent a blockade of its route.

Building the Hoover Dam, therefore, promises to be a story as interest-provoking as the digging of the Panama Canal, and The Review purposes, from time to time, to

report upon the progress made against natural handicaps. The site is in the "great American desert" of the 1840's, the period when the Senate was pinching pennies to revise Gadsden's treaty and move the international boundary 100 miles north of the mouth of the Colorado to a point near Yuma, Ariz., long conceded the hottest town in the United States with the possible exception of its more northerly rival, Needles, Calif.

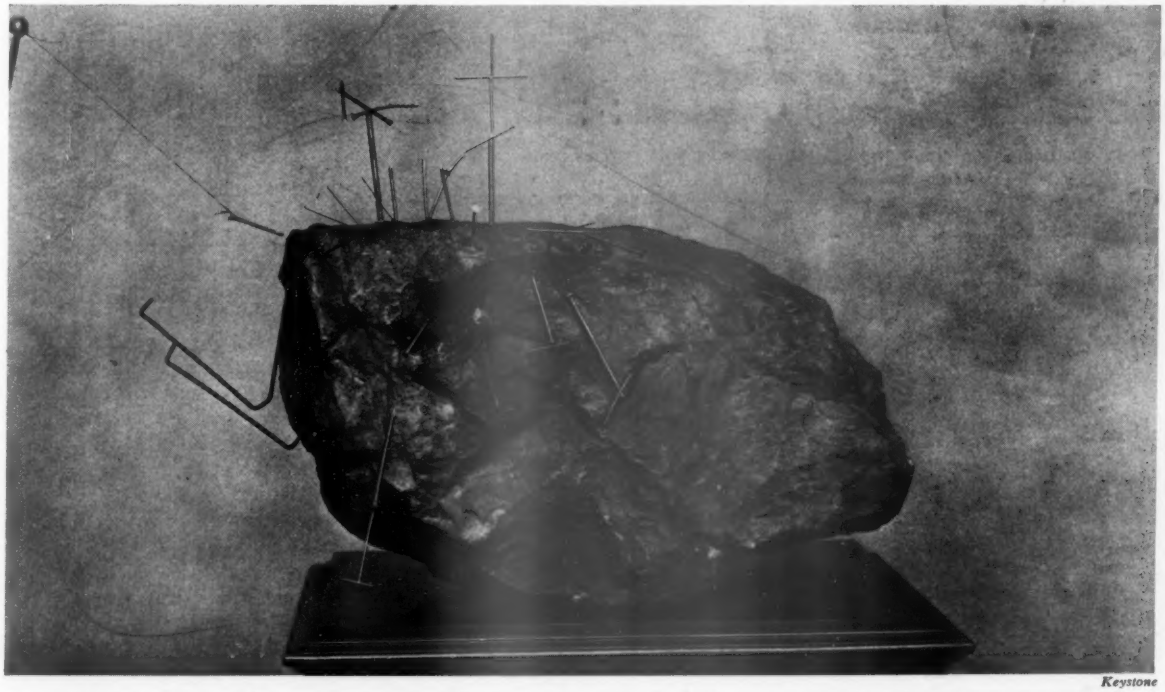
Already, in selecting a town site to house the horde of construction men working on the dam, climatic conditions have given trouble. Originally it was to be three miles from the river and 800 feet above it. In midsummer, however, test thermometers there registered 115°, so the location was removed three miles farther back to a spot 600 feet higher where thermometers registered but 108°. It is expected, fortunately, that artesian wells will make it unnecessary to pump water from the river to care for the 5,000 expected population of the new village, for which Nevada's two Senators have sought permission from the Federal Radio Commission to establish a broadcasting station.

Though puny in comparison with Hoover Dam, the completion of two similar projects this autumn and the announcement of a third have attracted notice. The finished dams are at Fifteen Miles Falls on the Connecticut River between St. Johnsbury, Vt., and Littleton, N. H., and at Conklingville, N. Y. The former is an earth dam, anchored with the largest retaining wall in the country and its hydroelectric plant, the largest in New England, is to develop about one-quarter of the amount expected from Hoover Dam; the latter is part of a system of barriers to regulate the Hudson. This flood control scheme is described in Mr. Sargent's article on Page 70. The third dam, announced last month, is to be erected by the West Kootenay Power and Light Company near the confluence of the Pend Oreille River with the Columbia. It will impound the entire flow of the Pend Oreille back to the British Columbia-U. S. border and will be 400 feet high.

Heat from the Stars

ON APRIL 29, 1924, Ernest Fox Nichols, the first to measure successfully the heat of the stars, delivered a paper on that subject before the National Academy of Sciences in Washington. Just as he concluded its presentation he quietly sank to the platform and died, the second President of the Institute to die speaking in the interest of science. Not only did he measure the heat radiation of a star, but he devised and perfected the radiometer which Charles G. Abbot, '94, Secretary of the Smithsonian Institution, has used so successfully in measuring the energy curves of stella spectra.

In defiance of a mortal disease, Dr. Nichols worked doggedly and fruitfully in this field of astrophysical research and succeeded in pointing the way toward measuring the diameter of stars and determining their life history by means of enormously delicate heat-measuring instruments. The story of his courageous career lies behind the perfection of a new thermocouple for measuring stella heat which was announced by the Carnegie Institution on September 20. This instrument, consisting of two hair-like wires, one of bismuth and the other of bismuth and tin welded together at the ends, will indicate a change in temperature of one-millionth of a degree Fahrenheit.



Keystone

NATURAL MAGNET OR LODESTONE, WEIGHING 400 POUNDS, NOW ON EXHIBITION IN THE FIELD MUSEUM OF NATURAL HISTORY, CHICAGO. IT WAS FOUND IN UTAH

Weber

STEEL AND GLASS CARRIED TO THE ULTIMATE IN BUILDING CONSTRUCTION. ADMINISTRATIVE BUILDING OF THE WORCESTER PRESSED STEEL COMPANY, DESIGNED BY J. D. LELAND AND COMPANY, BOSTON. ALL EXTERIOR DECORATIVE ELEMENTS ARE EXECUTED IN GLEAMING METAL, AND THE BUILDING'S SURFACES ARE PAINTED WITH SHINING ALUMINUM-BRONZE PAINT. SEE OPPOSITE PAGE

The thermocouple is placed in a telescope so that only the rays of the star to be measured fall upon the wires. The heat of the star creates a measurable current in the wires in the order of one twenty-billionth of an ampere.

Two days before the announcement of this instrument, engineers of the General Electric Company described a new vacuum tube which, used conjunctively with photo-electric cells, can measure a current, generated by star radiation, of one hundred-quadrillionth of an ampere.

At the Washburn Observatory in Madison, Wis., work is under way to adapt this new device to the 200-inch telescope for which Elihu Thomson is constructing a mirror of fused quartz in Lynn, Mass.

So do the powerful resources of modern physics steadily furnish means of peering into the mysteries of the universe. By means of them, as George Ellery Hale, '90, has said, the astrophysicist, pushing his researches into space, "exhibits conditions of temperature and pressure often transcending those attainable on earth, and thus presents for observation experiments on an immense scale, the interpretation of which has already added much to our knowledge of physics and chemistry."

The Home To Be

SECRETARY LAMONT of the Department of Commerce says that $50,000,000,000 will be spent on new residential construction in this country in the next 20 years, and $500,000,000 a year during the same period on maintenance and repairs of houses. Our building business ranks next to agriculture — every day it must care for 7,000 more people than the day previous — and, though skyscrapers receive the emphasis of public attention, especially when flagpoles vie with mooring masts for topmost records, the outgo for homes, even if Mr. Lamont be a couple of millions or so off in his estimates, is startling. By comparison, the quartet of towers (Empire State, Salmon, Squibb, and New York Trust) now adding 192 stories to New York's skyline represent an investment of $100,000,000, and not since 1924 has such a huge building program been undertaken on Fifth Avenue.

Yet it has been truly stated that, from the viewpoint of financing and modern mass production, American house building is still in the dark ages. President Hoover has pointed out that it is easier to finance the purchase of a short-lived automobile than to finance the purchase of a permanent home, and all students of building construction know how much is wasted once a house is financed. Instances of "minds at work on new structural systems or methods as applied to minor buildings" do exist, however, and the research of a Technology graduate who has carried out in actual construction new ideas based on a cube as a *structural module*, is described in the September issue of *The Industrial Bulletin* of Arthur D. Little, Inc.

Turning, however, to the discoveries of new materials and of new ways to use hitherto existing materials, the record is more abundant. Capital will not be available any longer for the shoddy construction now found in the "new slums" of too many suburban districts, in the opinion of Truman S. Morgan, President of the F. W. Dodge Corporation. Furthermore, with the availability of cheaper and better materials, Harry E. Freund, Director of the American Research Foundations, goes so far as to predict that tenements, and even skyscraper apartment buildings of the better class, will begin disappearing from American cities in the next ten years. While this as a dic-

tum might be open to question, Mr. Freund is supported by the fact that almost every American metropolitan center is showing highest population gains in outlying residential sections.

Wood, commonest of materials in housebuilding, has succumbed to the machine-age. It can now be treated and made more flame-proof than costlier materials; it is being supplied ready-cut in standard sizes direct from the lumber company to the job; it is being ground up and pressed out to make wall boarding, or shredded and sprayed with chemicals and puffed up to become insulating material to cut down heating bills. At this writing, intelligence of a new "metal wood" comes from the Kaiser Wilhelm Institute at Düsseldorf. It is a compound consisting, the report says, of "wood which has been blended with low fusing point metals, such as lead, tin, or alloys, while still retaining its structure" and "its power of swelling and its combustibility are very small."

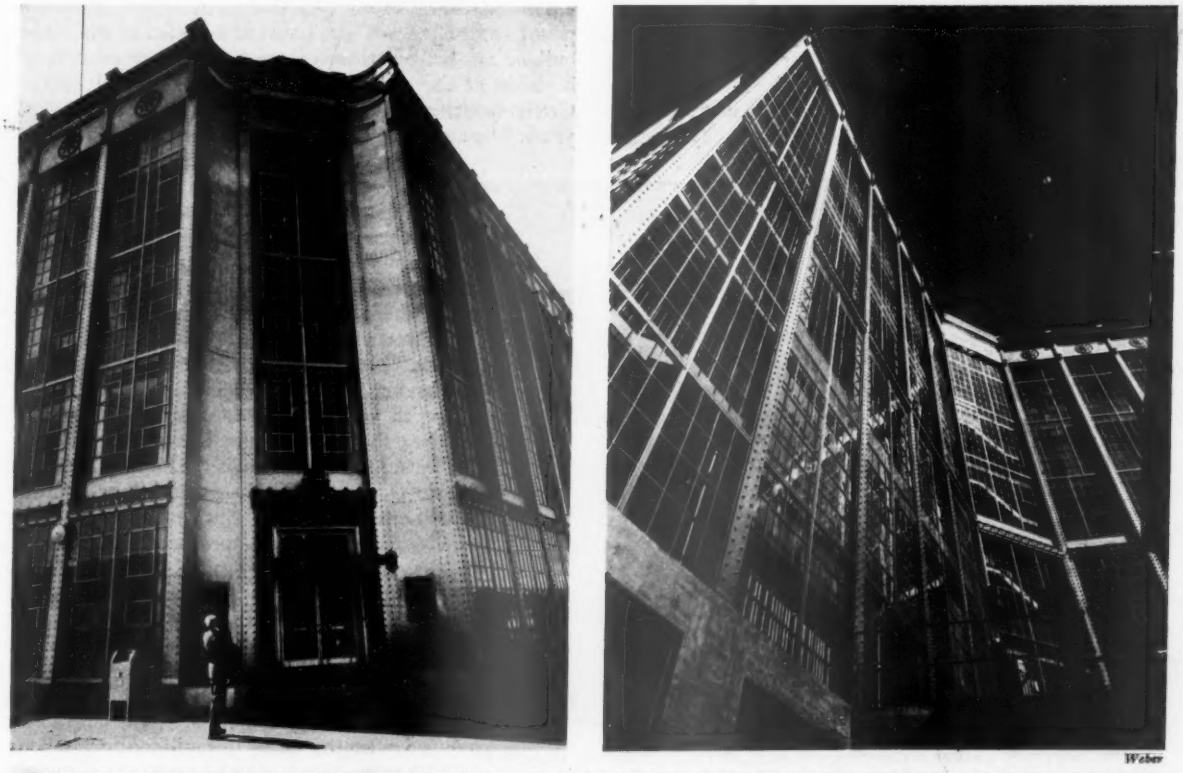
Materials in small units are undergoing the attack of heavy labor charges: shingled roofs of wood, slate, or asbestos face the competition of durable sheet metal of pleasing appearance, and of large thin composition or terra cotta slabs; floors made of small boards are proving no more worthy than single plastic slabs; the traditional three coats of plaster neither look nor wear better than wall board. Non-corrodible chrome steel, aerocrete (mentioned in the October Review), arc welding, and countless other new materials and processes are being seized upon eagerly by the builders of the larger buildings and may soon be employed commonly in residences.

Already the skyscraper of today bears little resemblance, either in its architectural design or construction, to that of 1920, and what has been happening to it may point the way to a different sort of smaller building. Tradition, as it should, counts heavily where the home is concerned and there need be little fear of a utilitarian box period. But the avidity with which the American people have accepted plumbing, central heating, gas and electricity, and the horde of mechanical gadgets which followed, indicates a readiness to adopt the new if its claim appear reasonable.

It would thus appear certain that the American home is due to enter upon an era of change from which it may issue with a much altered conception of its design. Possibly the era will be as momentous — and let us hope fervently, as gratifying — as that which saw the overthrow of Victorian Gothic, mansard roofs, oriels, porte-cochères, and the other symptoms of the architectural colic of the Parvenu Period, the Reign of Terror of the 1870's and 1880's.

Tribulations of a Merchant Marine

GOVERNOR John Winthrop in the 1630's launched at Boston, the 30-ton sloop *Blessing of the Bay*, America's first contribution to ship building, and by 1700 a thousand vessels were plying out of New England ports. Since that auspicious beginning, the American Merchant Marine has had many ups and downs. Of the ups may be mentioned: the growth of the whaling industry centering



Weber

A SYSTEM OF LEAD JOINTS HAVE BEEN DEVISED SO THAT THE CONTRACTION AND EXPANSION OF THE STEEL WORK WILL NOT CRUSH THE GLASS WALLS. THE ENTRANCE DOORS AND ARCHITRAVES ARE WROUGHT FROM STAINLESS STEEL

in Nantucket and New Bedford; Nathaniel Bowditch's preparation of "The American Practical Navigator," containing the first workable system of navigation; his record-breaking trips to the Far East in the *Astrea* and *Putnam;* the resulting developments of the golden age of the clipper ship; the building and sailing of the Baltimore privateers in the War of 1812; the creation of the *Savannah* which crossed the Atlantic partly by steam power in 1819; the operation of the Black Ball line, the first to run on regular schedules.

The reverse of the picture is represented by conditions after the Revolution when Congress was obliged to invent a subsidy, the Hamilton tariffs which fixed port dues for American ships only one-third as high as for those under foreign flags; by Jefferson's embargo which in one year shrank our sea-going commerce to a fifth of its previous volume and by his later non-intercourse acts against the British and French. When recovery from these had been accomplished so that about two-thirds of our commerce was being carried in American bottoms, the Civil War took place. According to Commodore Herbert Hartley, "the history of our merchant service for the next 50 years could be written in a sentence; we had no merchant marine history."

The Great War brought a revival in shipbuilding, and American yards produced the greatest fleet of sea-going vessels ever completed within a comparable period. Created by Congress in 1916, the United States Shipping Board was charged with "encouraging, developing and creating a naval auxiliary and naval reserve and merchant marine . . . ; to regulate carriers engaged in foreign and interstate commerce of the United States. . . ." It found the country had only 61 shipbuilding yards with 234 ways (more than a third of the yards were only equipped to build wooden ships), but at the Armstice it could count 223 yards with a total of 1,099 ways. In 1918 its operating subsidiary, the Emergency Fleet Corporation (changed in 1927 to the Merchant Fleet Corporation) controlled a total fleet of 1,196 vessels of over 6,500,000 tons.

In 1920 Congress decided it would be the policy of the United States to have an adequate peace-time merchant marine and assigned responsibility for its development to the Shipping Board without giving particular instructions as to how the end should be accomplished. Against heavy odds the Board resolutely tackled the seemingly impossible task and now, at the close of a ten-year period, can point with pride to a record of accomplishment during which the center of gravity has been shifted from public to private ownership.

At first it undertook to determine what services were actually needed and determined upon 77 trade routes, later consolidated to 38. These did not include existing private lines under American registry or tramp services, nor was it supposed that the system of lines laid out by the Board would be final. "It was adapted to the needs of the country as the Board saw them at the time," says Chairman T. V. O'Connor, and the policy "was not to have American vessels monopolize American overseas trade, but to build up a permanent fleet that would be capable of transporting more than half of our foreign commerce."

Private operation was the goal but this was to be a long process and at first the best that could be done was to get private companies to act as operating agents for the Board which retained the risks. Ships were then offered at a very attractive prices and after five years this scheme was working well. It was clear, however, that United States shipping was at a severe disadvantage due to low foreign construction and operating costs.

This condition was effectively remedied in 1928 by the passage of the Jones-White Law under which an American builder can borrow three quarters of the capital cost of his ship at the same rate of interest as is paid by the Government, and the loan period may extend over 20 years. The act also makes it much easier for the Shipping Board to sell its vessels to private owners and provides a means to bring about the ultimate elimination of the Government as an operating factor.

By allowing mail contracts to be made for ten-year periods, and by authorizing a higher rate of pay for carrying mail, an inducement is offered to compensate for the higher construction costs and the higher expense of operation as compared with vessels under foreign registry. Now, too, the holder of a mail contract can know better where he stands for he will not have to face annually the possible non-renewal of one of his important sources of revenue. Moreover, the rate per pound per mile is based on a sliding scale depending on the ship's speed, and a 20-knot express steamer will get over five times the rate given a 10-knot boat. Thus an owner can afford to undertake the greater risks attendant upon building swifter vessels as well as their increased operating costs.

Under the terms of mail contracts about 70 new ships are to be constructed during the next eight years. The best immediate

M. I. T. Photo

IN THE INSTITUTE'S RIVER HYDRAULIC LABORATORY: UTILIZING THE PRINCIPLE OF SIMILITUDE TO ASCERTAIN FROM A MODEL THE PROPERTIES OF A DAM SPILLWAY. THE PLUME OF WATER IN ACTUAL SIZE WOULD BE 40 FEET HIGH

examples are to be found in the $13,000,000 program for three "AGWI" liners: the *Morro Castle* commissioned last August, the *Oriente* to be commissioned next month, and the *Borinquen* to become in January the flagship of the New York and Porto Rico S.S. Company, or the four prospective $5,000,000 vessels of the Panama Mail S.S. Company.

Expressed in figures the good result of the Jones-White act is demonstrated by the fact that the Board is now operating 17 routes of 96, the remaining 79 are being operated by 25 private companies; 151 vessels have been sold to private operators since January, 1929; the cost of the Board and the Merchant Fleet Corporation to the Government in fiscal 1931 will be half what it was in fiscal 1929. In round numbers there are now 700 ships, representing an increase in tonnage of 550% over 1914.

M. I. T. Photo

IN THE INSTITUTE'S RESEARCH LABORATORY OF PHYSICAL CHEMISTRY: APPARATUS USED IN OBTAINING VERY PURE WATER, ENTIRELY FREE FROM DISSOLVED GASSES. THE PURIFIED WATER IS UTILIZED IN DETERMINING THE PROPERTIES OF STEAM AT HIGH PRESSURES. SEE OCTOBER REVIEW, PAGE 18

Higher and Longer: Being the Account of a Pipe-Dream and a Near-Reality

ENGINEERS are now speculating upon the possibility of a Babel-like structure 5,280 feet high which will exceed five times the height of the Eiffel Tower. Before the New York Section of the American Welding Society, Gilbert D. Fish, a consulting engineer for Westinghouse, told his colleagues that it would be practicable to build such a structure.

The proposed mile-high tower would be 528 feet square at the base, and it would take 19,000 tons of steel for the entire construction. This does not include any allowance for landing stages, observation galleries, elevator hatch framing, and other framing which would be needed to make the tower useful; the weight of these extras and the additional material in the main tower to carry the added load might bring the total to 25,000 tons.

For the sake of comparison, it is interesting to note here the heights of two famous New York buildings: The Empire State Building with its dirigible mooring mast is to be 1,248 feet; and the Chrysler building is 1,046 feet to the top of the spire. Although the design of the speculated mile-high tower calls for only 25,000 tons of steel, the Empire State Building required more than 46,000 tons, indicating how everything is sacrificed to height in this pipe-dream tower.

Although Mr. Fish did not indicate what use could be made of this huge steel needle, such a tower, or even taller ones might be erected for scientific purposes, for service in connection with aviation, for advertising, or for public amusement. It is evident that a tower lacking solid walls and solid floors can be built far higher than any other building structure, although at present no figures have been computed limiting heights as governed by strength and weight of available materials.

While the mile-high tower is but yet a speculation, the plans for the longest bridge in the world which will span the Golden Gate of San Francisco, are to become a reality. The Golden Gate Bridge will be started next spring and finished in 1935, providing a bond issue to furnish funds is authorized in the November California elections. It will have a single span 4,200 feet long, exceeding by 700 feet the present world's record suspension bridge across the Hudson River in New York, which is now being finished. Scientists have made use of synthetic earthquakes, which are manufactured at the Stanford University Engineering School, in planning this 4,200 feet Golden Gate Span.

It is estimated that several millions of dollars will be saved in the construction of this bridge by using what is known as the deflection theory. This theory maintains that the gigantic cable, the steel members holding the floor of the bridge, and the stiffening steel that makes the bridge rigid all act as one elastic structure. Because of this engineers find that parts of the bridge do not need to be designed for such large tensions and compressions as would be the case under the older theory. This allows a lightening of steel, and thus a saving of money. Professor Charles Derlett, Jr., who is one of the designers, claims that if the Golden Gate Bridge were constructed according to the old theory, it would cost $3,000,000 or $4,000,000 more than the estimated cost of $33,000,000.

Hot Spot

THE highest temperature ever produced on earth, estimated at 900,000°, has been roughly measured by R. Tanberg, of the Westinghouse Electric and Manufacturing Company's research laboratories. This was found on a small spot on the crater of the metallic electrodes between which an electric arc was maintained inside a special type of vacuum tube. Previously the hottest known spot was on the crater of an ordinary arc light which reached 10,000°.

Pounds, Shillings, Pence

AN EXPOSITION of Technology's fiscal 1930, which ended June 30 last, is to be found in the 64-page document presented to the Corporation last month as the annual Report of the Treasurer by Everett Morss, '85. It shows that the Institute's net operating income exceeded the $2,000,000 mark for the fifth consecutive year and was less than $400 short of being two and three-quarters millions.

Capital gifts during the fiscal year amounted to $589,439.16 and included: for student aid, $100,000 from Professor and Mrs. William Emerson and $141,845 from the estate of James H. Haste, '96; for dormitories, $50,000 from Charles Hayden, '90, and a like amount from the estate of Charles W. Goodale, '75. Miscellaneous gifts totaled $63,808.46.

Gross expense for the year exceeded gross income by $390,107 and net expense exceeded net income by $23,059, leaving the current surplus shown on the Treasurer's balance sheet as $22,395. Income from students was $1,267,869, or $92,000 more than in fiscal 1929. Of this increase, $17,300 came from the greater return of the 1929 Summer Session as compared with that of 1928.

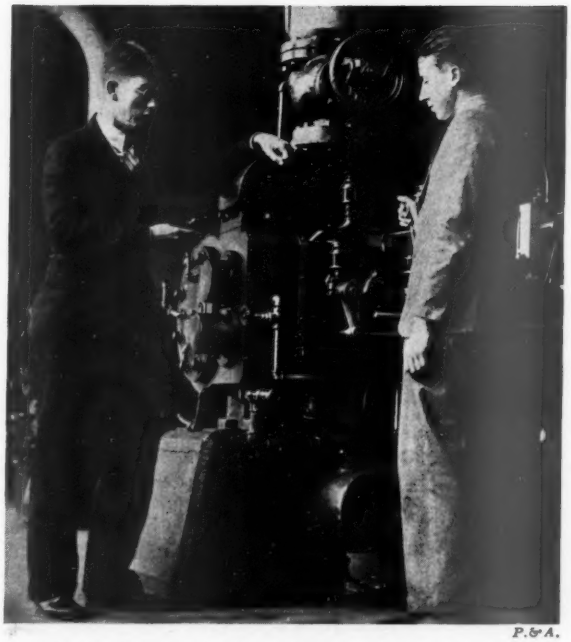
Net operating expense during fiscal 1930 was at the rate of $7,600 per day (not including $3,100 per day for research and special payments) as against $7,150, $6,300, $6,200, $6,000, and $5,444 in the five previous years. Academic expenses increased $85,763 or 5.5% over fiscal 1929; administration costs increased $45,859 or 16.6% ($23,160 being due to Inauguration, receptions and extraordinary charges): plant operation and maintenance increased $9,594 or 2.3%; miscellaneous expenses increased $12,431 or 6.8%.

The Institute's total investments, as of June 30, 1930, had a book value of $33,148,985.38. Due to special circumstances, the Eastman Contract and 10 other funds are separately invested, the remaining 150 other funds (amounting to about two-thirds of the total) are consolidated into a General Investment Account. Concerning this Mr. Morss says:

"For some years we have been building up an Endowment Reserve Fund to protect the securities in the General Investment Account from loss and to insure a uniform income return for the funds participating in this account.

"During the year the Endowment Reserve Fund has been increased about $956,000 by realized profits on the sale of certain securities. The fund was further increased

PORTRAIT OF THE LATE DEAN HENRY P. TALBOT, '85 (1864–1927). THE PAINTING, EXECUTED BY E. POLLAK-OTTENDORFF OF BOSTON, IS TO HAVE ITS FIRST SHOWING IN THE OFFICE OF THE DEAN ON NOVEMBER 20



P.&A.

TWO OF THE EDISON SCHOLARSHIP STUDENTS AT THE INSTITUTE: WILBER B. HUSTON, '33, WINNER IN 1929, AND ARTHUR O. WILLIAMS, '34, WINNER IN 1930. TWO OTHERS OF THE 1929 CONTESTANTS, RATED SECOND AND THIRD BY EDISON AND HIS COMMITTEE, ARE ALSO STUDYING AT TECHNOLOGY

by $1,740,000 by marking up certain securities from their original cost part way toward the present market. From the Endowment Reserve Fund as it then stood, a distribution of $2,680,000 has been made to all the participating funds in the General Reserve Account, thereby increasing their principal value about 15 per cent.

"As a result we shall have a somewhat lower net yield on the principal of our investments, but it will permit us to add other funds to the General Investment Account without injustice to the older funds in the same account."

Comparison of the Treasurer's Reports for fiscal 1930 and fiscal 1920 develops many contrasts. The Institute's registration was practically the same for each of the years covered, being 3,078 for 1919–20 and 3,066 for 1929–30, the rise to the high point of 3,505 having come during 1921–22. But, in fiscal 1920 52% of the Institute's total net income derived from students, in fiscal 1930 46%; salaries to teachers in 1920 constituted 38% of net outgo, in 1930 44%; of the income from students during fiscal 1920 only 75% went for salaries to teachers, while in 1930 96% was used for that purpose.

Other changes during the decade are shown below:

(000's and cents omitted)

	Fiscal 1920	*Fiscal 1930*	*% Increase*
Income			
From students	$771	$1,267	64
From Investments	525	1,702	224
Expense			
Salaries of teachers	588	1,317	124
Total academic expense	679	1,613	137
Administration costs	252	321	27
Plant operation and maintenance	329	426	29
Capital			
Book value Educational Plant	$10,792	$14,009	29
Total Funds	14,914	33,148	122

Postlude on Registration

REGISTRAR MacKinnon's predictions announced in the October Review were that a rise of 8% in entering freshmen would be obtained for 1930–31 and that the Institute's total registration this year would exceed the 1929–30 figure by 4%. As of October 1 (the third day of the present term), there actually were 35 more freshmen enrolled (5% increase) and in all 3,187 students (4.9% more than last year). This total registration figure maintains a steady increase which has been noted each year since the post-war low point of 2,671 in 1926–27. With two exceptions (1920–21, 3,436; and 1921–22, 3,505) it has never been exceeded.

This year freshmen number 737, up 35 from last year; sophomores 667, up 23; juniors 599, down 15; seniors 614, up 38; graduate students 512, up 95; unclassified students 58, down 26.

Seven departments have more than 200 students: Electrical Engineering (Courses VI, VI-A, VI-C) 521, up 39 from 1929–30; Chemical Engineering (Courses X, X-A, X-B) 403, up 20; Mechanical Engineering (Course II) 362, up 61; Engineering Administration (Course XV) 346, up 48; Architecture and Architectural Engineering (Courses IV, IV-A) 271, down 24; Civil and Sanitary Engineering (Courses I, I-A, XI) 244, down 7; and Aeronautical Engineering (Course XVI) 232, down 46.

Photographic Service

FROM humble beginnings in a corner of a laboratory there has grown up in Technology a thoroughly equipped and highly efficient Photographic Service which meets the Institute's need for photography in its various forms, from photomicrography to formal portraiture.

The laboratory was designed for straight line production and no single operator need move more than eight feet to carry on his work in any of the rooms of the laboratory.

The lighting system includes every type of light from diffused flood lighting to spot lights and controlled natural light. The various operating rooms of the service are separated by light locks, which does away with the necessity for doors and eliminates the danger of destroying work in process of development. Between the developing room and the printing laboratory is a specially designed drying chamber where a current of electrically warmed air is employed to dry films and plates. The time for this process has been reduced from six to eight hours by old methods, to 45 minutes in the drying chamber. Various types of printing machines are used, and the washing equipment has a capacity of more than 500 prints at one operation. Rotary and cabinet print drying equipment brings the work to the final stage of finishing at a point that places it within reach of the delivery desk.

Examples of the work of this Service may be seen frequently in the pages of The Review. Already there are thousands of negatives on file and the service has become as indispensable as the Photostat and Blueprint services.

THE WASHINGTON NOBODY KNOWS

(Continued from page 81)

Washington channel is also the yacht harbor of the District. The United States owns all of this frontage and, with the proposed improvement for well designed piers and bulkheads, there will have been provided "a water front at the seat of government worthy of the dignity and prestige of the nation."

The lone aqueduct which, since 1863, had brought water from Great Falls in the upper Potomac to the capital had been carefully guarded during the war lest its destruction by the act of an enemy bring disaster. Washington was using its capacity flow and suddenly awakened to the narrow escape it had had. Another conduit of greater capacity was planned and built and a filter plant and pumping station constructed, which more than doubled the available supply of pure water.

The old conduit built into one of the famous aqueduct bridges of the world, the Cabin John Arch, afforded a flow line aqueduct from intake to outlet. The most striking feature of the new waterline is the crossing of Cabin John Creek by a reinforced concrete siphon of circular section, with an inside diameter of nine feet, which conforms closely to the natural surface and leaves the historic bridge untouched and the view of its graceful arch unobstructed.

Over the old and new aqueducts, which lie side by side in this federal owned strip, is the conduit road, which will be reconstructed as a boulevard from Washington to Great Falls in Maryland, affording a most attractive drive with enchanting views of the upper river, the Virginia Palisades and the Great Falls, of which Lord Bryce wrote, "No European city has so noble a cataract in its vicinity as the Great Falls of the Potomac, a magnificent piece of scenery which you will, of course, always preserve."

The most vital of public utilities, sanitation, unseen and unknown by the average citizen, has in the past ten years called for an outlay exceeded by three times that spent in the preceding decade. In the five years just past there has been expended for large mains and pipe sewers in the District of Columbia more than $6,000,000 as compared with two and a quarter million in the five years before. Today there are more than 200 miles of main concrete sewers in Washington.

This increase in expenditures reflects not only a normal growth but also reflects closer coordination of sewer construction with city planning. No street in Washington is now paved or repaved until the necessary sewers are installed, or if required, enlarged or reconstructed. This, as it may readily be seen, eliminates the tearing up of new streets.

The recent impetus given to the creation of new parks and the development of existing parks has had much to do with the change of sewer design from the combined to the independent system. Many streams passing through the district have their source in Maryland, and an agreement made in 1924 created a metropolitan area in which the sewers of Washington are, or will be, utilized as outlets for Maryland sewage, thereby avoiding the pollution of waterways in Rock Creek and other parks of the District so justly famed for their great natural beauty. The question of coordination of park development with sewerage and storm water control is probably given more serious consideration in Washington than elsewhere, as in the personnel of that most valuable adjunct to the National Capital Park and Planning Commission, the "Coordinating Committee," is included a drainage and sewer expert.

Another small factor, but one which makes Washington more livable and which has recently been adopted as a municipal activity, is mosquito control. With some 8,000 storm water catch basins it was discovered that there were 8,000 sources for mosquito breeding, and that each basin contains a stagnant pool in its bottom, nice and dark as though built for the purpose. The spraying of these basins with gas oil once each seven days during the eight warm months of the year does not cost much and does make life more pleasant and healthful.

THE livable qualities of Washington have been wonderfully developed in the last decade. Intelligent planning to fit varied topography has made new residence sections most attractive. While the steam shovel and the axe were not restrained in time to save some beauty spots, many hills and dales beautifully wooded have been reclaimed by skillful landscaping. The Federal Government's building program, which we can merely refer to, is now well under way. It is of such magnitude and beauty as to fully satisfy the thought of President Hoover when he said:

"It is the wish and demand of the American people that our new buildings shall comport with the dignity of the capital of America, that they shall meet modern requirements of utility, that they shall fulfill the standards of taste, that they shall be a lasting inspiration. In architecture it is the spiritual impulse that counts. These buildings should express the ideals and standards of our times; they will be the measure of our skill and taste, by which we shall be judged by our children's children."

Washington's own need for new buildings, exclusive of Federal projects, has required an investment of $420,000,000 in new construction during the last nine years. It is to the city's credit that 41,000 residential and apartment structures have been built since 1920, providing housing for a population equal to that of the cities of Syracuse or New Haven, without interfering with the architectural scheme which is destined to make Washington a truly magnificent capital.

No structures in the downtown section may exceed 110 feet in height on the street front with a maximum height of 130 feet obtained by the use of setbacks. The result has been a wide distribution of business buildings accompanied by a general excellence of architecture.

By what tests shall "livability" be measured? A distinguished American planner suggests, "public health, well-being, and safety, with sunlight and the quality of urban air, with the increase of comfort and beauty, with new opportunities for fun and amusement, and with fitness of cities as an environment for new generations." Washington, in the opinion of one who lived there twelve years, satisfies these tests in a greater degree than any other American city.

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PROMETHEUS ENCHAINED

(*Continued from page 69*)

enormously diminished, the accident rate drastically reduced, and a cleaner, safer, more comfortable, more sightly, more integrated nation have been our heritage.

I speak of the *engineering mind*. This is not to be confused, alas, with the average engineer as we know him. At the beck and call of the business man, the poor fellow can hardly be said to have a mind of his own. He is narrow, near-sighted, over-specialized — even as is his master. He has no more sense of state than a rabbit. But before he was yoked to the treadmill, there may have been moments when he glimpsed the dignity, the responsibility, the supreme challenge of his profession; when for one lucid interval he may have realized that he belonged to the most important group in the modern world; that indeed he had the world in his keeping. A few individuals (I will mention no names) have kept the realization untarnished, and that is what I mean by the engineering mind.

It is a mind that is professional, not commercial; dedicated to building, not to profit-making; that is done with false modesty and has the courage to accept the job of taming the billion wild horses which Watt let loose; that thinks straight and hard; hates waste and confusion, dirt and despair; that never stoops to the shoddy or the adulterated.

Plato once called for philosopher kings. Today the greatest need in all the bewildered world is for philosopher engineers.

HARNESSING THE HUDSON

(*Continued from page 72*)

investigations by the state and the Board. Such a project would have had a total storage capacity of 7.8 billion cubic feet, whereas the dam as now built, with a crest elevation of 771 feet above mean sea level, creates a total capacity of 37.8 billion cubic feet and an available capacity above elevation 740, the low draft elevation, of 30.0 billion cubic feet.

Following the floods of 1902, the Legislature passed Chapter 406 of the Laws of 1902, creating the Water Storage Commission, "to investigate the causes of floods and overflows of river and water courses and make recommendations for preventing the same and making an appropriation therefor."

The Water Storage Commission made an extensive investigation and submitted an elaborate report to the Legislature, stating, "legislation providing for such a system of river regulation is in our opinion a great and urgent public necessity," and recommending the creation of a permanent commission to construct and maintain an adequate system of river improvement in the state. It is interesting to note that their thought,

> "the central idea should be that the entire cost of the execution and maintenance of each of the various separate works comprising such a system should be borne by the beneficiaries in proportion to the benefits they respectively derive from it,"

is written into the present river regulation act in almost that exact language. (*Continued on page 98*)

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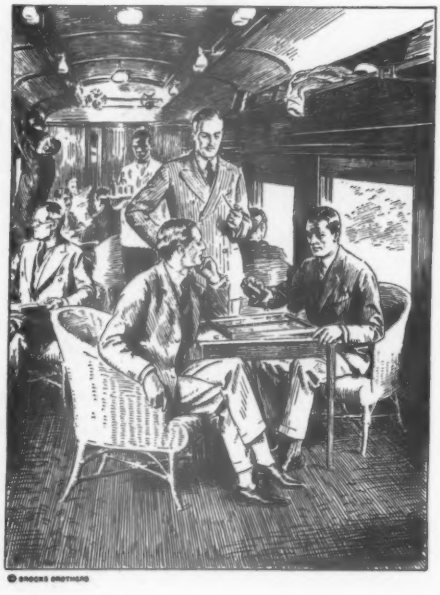

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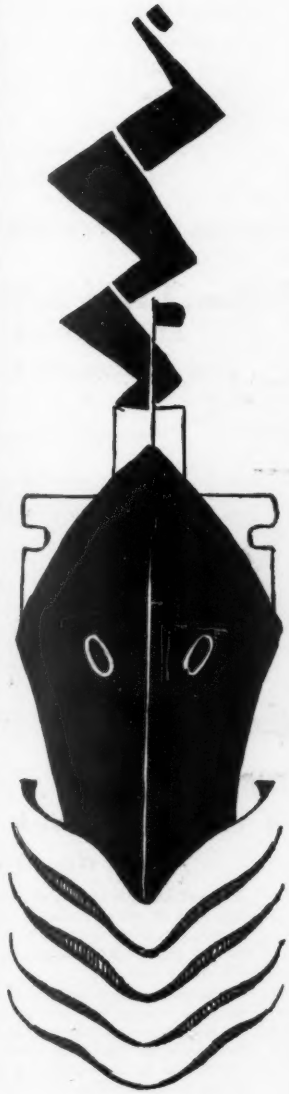

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Brown & Sharpe Cutters
Lower Production Costs

HARNESSING THE HUDSON

(Continued from page 96)

Up to 1906 the streams had been studied almost entirely from the viewpoint of navigation and flood prevention. Water power had been considered only as an incidental matter, but the growing interest in the conservation of natural resources, especially of water power, resulted in 1907 in the passage of an act authorizing the State Water Supply Commission to make an investigation of the water power and storage resources of the state. Immediately on the passage of this law the commission began elaborate surveys of the entire Sacandaga Reservoir Basin, and in 1908 a most comprehensive report was prepared by the commission's consulting engineer, John R. Freeman, '76, and submitted by the commission to the Legislature.

The flood in 1913 again focused the attention of the people of the state of New York on the necessity for water storage and during the session of 1915 the Legislature passed the Water Storage Law, chapter 662, of the Laws of 1915, providing for the creation of river regulating districts. In July, 1922, the Water Control Commission of New York received a petition from the City of Glens Falls and others praying that the territory constituting the watershed of the Hudson River and its tributaries within the state above the intersection of the southerly boundary lines of the counties of Albany and Rensselaer with the Hudson River, excepting therefrom the watershed of the Mohawk River, be created into the Hudson River Regulating District. In pursuance to the provisions of Article VII-A of the Conservation Law, hearings were held by the Water Control Commission and in August, 1922, the petition was granted and a final order entered by the commission creating the new district.

Hon. Henry M. Sage, Hon. Erskine C. Rogers, and Hon. Edgar H. Betts were appointed members of the Board of this district and the writer was appointed Chief Engineer.

The first duty of a regulating district is to prepare a general plan for the regulation of the flow of the streams in the watershed. Accordingly, a general plan for the regulation of the flow of the Hudson River was prepared which calls for the eventual construction of sixteen storage reservoirs on the Hudson, Sacandaga, Schroon, Indian, and Cedar Rivers and other tributaries, having a total capacity of 80 billion cubic feet and estimated cost of over $30,000,000.

The general plan was certified to the Water Control Commission and approved by it with certain modifications in June, 1923, and under the law became the official plan regulation of the Hudson River flow and certain of its tributaries. As has been noted, this plan included the Sacandaga Reservoir and the Board in pursuance of the provisions of Section 450 of the River Regulating Act prepared the Preliminary Plans of the reservoir, which would be created by a dam about 100 feet high at Conklingville, Saratoga County. These maps, plans, and specifications were adopted by the Board in January, 1924, and approved with slight modification by the Water Control Commission.

The Board's next step was to make the apportionment of the cost of the reservoir and, after *(Continued on page 100)*

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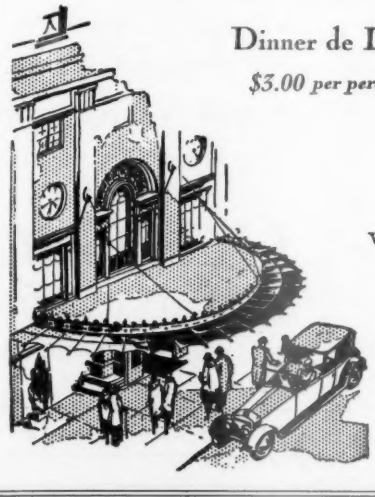

WALTON H. MARSHALL
Manager

HARNESSING THE HUDSON

(*Continued from page 98*)

a great deal of study by the engineering staff, the Board adopted in January, 1925, the apportionment of cost which provided that the cost of the Sacandaga Reservoir should be apportioned among the beneficiaries in proportion to the benefits inuring to them.

The largest of the reservoirs is the Sacandaga, with a total capacity of 38 billion cubic feet (875,000 acre feet), but to prevent unsanitary or unsightly conditions in case of too great a depletion, the last 40 feet of storage will not be drawn but permanently impounded so that the available storage is 30 billion cubic feet.

The Sacandaga Reservoir, costing approximately $12,000,000, has been created on a large scale with an area of 42.3 square miles, almost identical with the area of Lake George. It is nearly 30 miles long and six miles wide at its widest section. The watershed at Conklingville is 1,040 square miles, and its storage capacity will nearly completely control the flow of the river. The capacity was decided upon after elaborate topographic surveys of the reservoir had been made and area and capacity curves drawn. A stream gaging station just below the dam site, which was established in 1907, furnished the data necessary for the mass curve studies. The next step was to make estimates of the cost of the reservoir for various elevations and these data, with the stream flow records and the capacity curve, made it possible to determine the economic limit of storage. Fortunately, in this case, it was found possible to impound practically all the flow available in an average year. Diamond drill and other borings were made to reveal the geological conditions at the dam site so that a determination might be reached as to the proper type of dam to be built. It was found that there existed at Conklingville a pre-glacial gorge over 200 feet deep, which precluded the construction of a masonry dam, so it was decided to build an earth dam of the modified hydraulic fill type. Fortunately, rock of the granitic gneissic type existed on the north side of the dam site, making it feasible to construct a concrete spillway for the discharge of any excess flow. This 400-foot spillway (there being also incorporated in the outlet structure the largest siphon spillway yet built) has a capacity for a flow 50% greater than the 1913 flood, even assuming the reservoir full at the inception of the flood. This is an extremely remote possibility, but the volume of storage impounded in the Sacandaga Reservoir is so great that a large factor of safety is advisable.

The construction of the reservoir required other work than the construction of the Conklingville Dam. In fact, 17 separate contracts have been awarded with one minor job now under preparation. First, it was required to construct new highways around the shores of the reservoir, totalling nearly 40 miles of gravel roads and about five miles of state highway relocation. There were over 12,000 acres of timber lands (*Concluded on page 102*)

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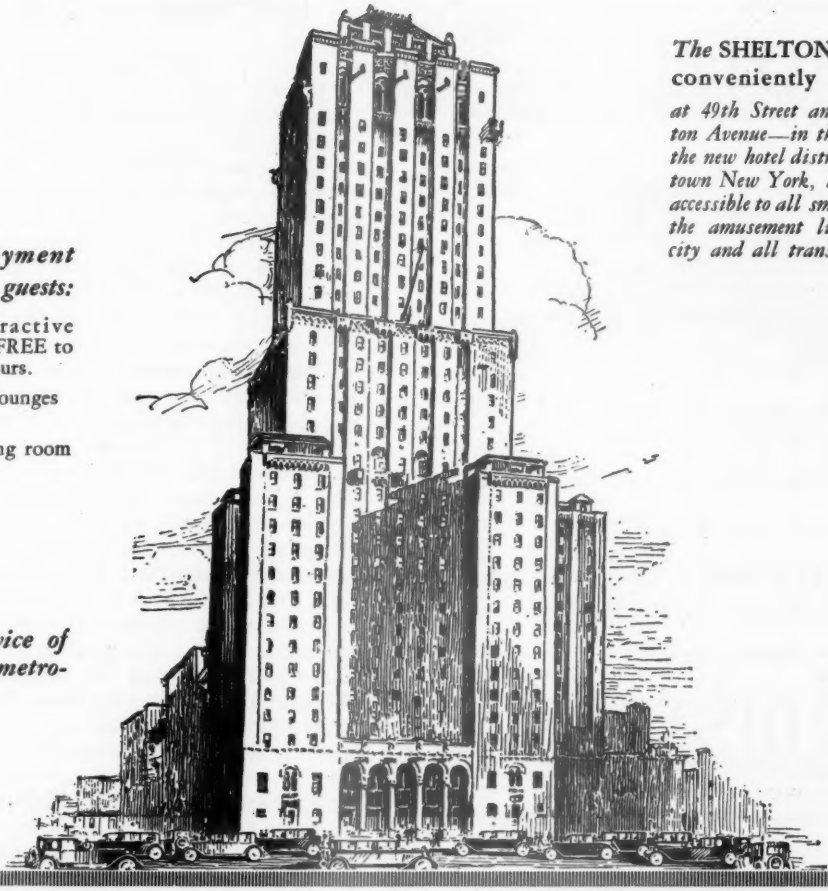

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HARNESSING THE HUDSON

(*Concluded from page 100*)

in the reservoir that had to be cleared; 3,800 graves in 26 cemeteries had to be moved into the six new cemeteries which the Board constructed or into existing cemeteries above the shore line of the reservoir. A new highway bridge of three spans, each 180 feet long, has been built at Northville, and at Batchellerville a bridge is being constructed to cross the reservoir. The Batchellerville Bridge includes 19 spans, each 150 feet long and two spans one-half that length. Also at Northville there has been built an earth dam over an arm of the reservoir with a highway on top of the dam. The dam was built to maintain water permanently at the reservoir crest and to avoid creating unsanitary conditions at the village due to any draft of the reservoir.

Because of the litigation between the Board and the Fonda, Johnstown and Gloversville Railroad Company, a portion of the tracks of which were to be flooded by the Sacandaga Reservoir, it was not possible to let the first contract for the actual construction until the spring of 1927. Approximately 1,200 separate parcels of land covering an area of 45.5 square miles had to be acquired for the reservoir. Under the law, titles to all property must be taken in the name of the people of the state of New York, and therefore every taking had to be approved by state officials. As in the case of property located far from the centers of population, many instruments relating to titles were not recorded and considerable investigation was necessary in order that all future claims on the real property taken could be nullified. Titles to some of the required land were so involved that it was necessary to resort to condemnation and every available method of securing judicial sanction to the acquisition. It was necessary to institute condemnation proceedings in about 125 cases although this does not mean that all of the parties involved in these condemnations were unable to agree, for there were instances when condemnation was the only method whereby titles could be cleared. Parties having an interest in property were scattered from coast to coast, and some as far distant as Australia. Twenty-six different commissions were appointed in condemnation proceedings comprising some 60 different attorneys and business men. The greatest difficulty was with the railroad above mentioned. After much litigation this barrier was at last removed and the construction of the reservoir went ahead.

Of course, the work of the Board of the Hudson River Regulating District has been facilitated by the fact that the Hudson River lies within the boundaries of one state. It demonstrates, nevertheless, what engineering can do toward preventing floods, and incidentally in furnishing new sources of power, for it is believed that within ten years there will be an installation of hydro-electric machinery along the banks of the Hudson that will exceed twice the present installation on the American side of the Niagara River. So the Sacandaga Reservoir will be a mighty balance wheel in the Hudson River system, and when additional reservoirs are completed the Hudson River will be a stream almost completely governed in its action by the people of the state of New York.

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THE U. S. S. R.

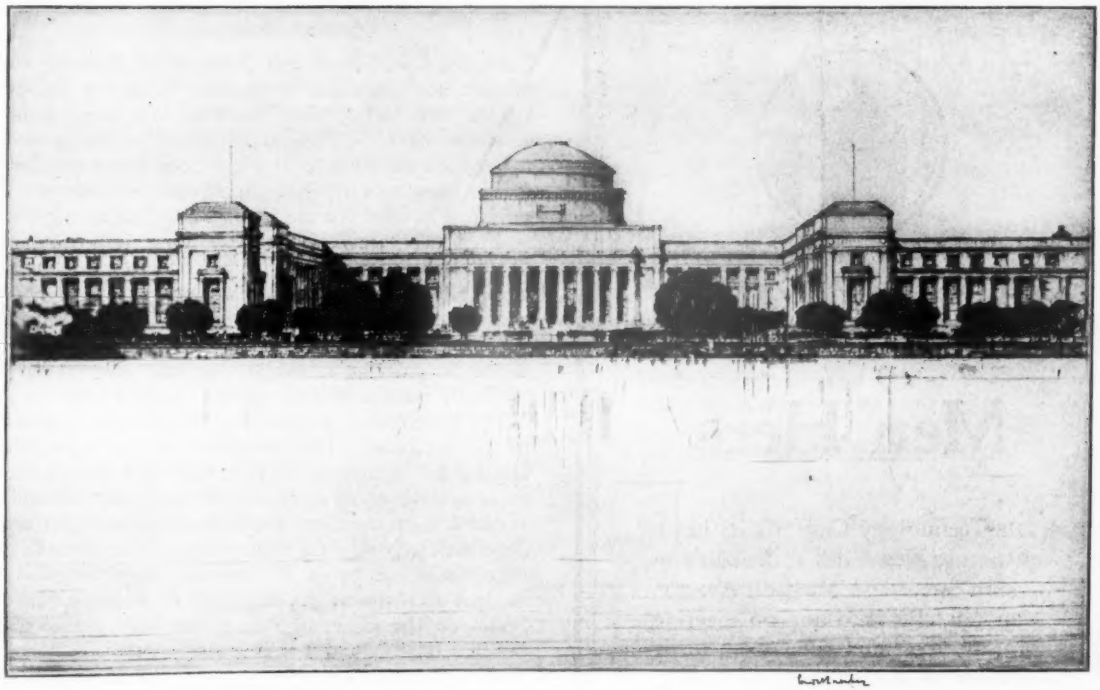
(Continued from page 78)

During the seven years of the World and civil wars live stock gradually disappeared, and most of these newly created farmers found themselves owners of small farms, but without the means of cultivating them. For years the government has tried, so far as its resources allowed, to help the poor farmers to acquire the necessary live stock and agricultural implements to cultivate their land effectively. Some of these have succeeded in meeting the difficulties of the situation, but the improvident and the less enterprising — and they were in the majority — were losing out in their struggle and began hiring themselves and their land out to their more enterprising neighbors, and so gradually a small land-owner class developed. The leaders of the revolution felt that if this were to continue unchecked, the fruits of the revolution, the complete liberation of the peasant, would soon be forfeited. It became necessary, therefore, to protect the less enterprising peasant from exploitation at the hands of the more energetic, and to improve and modernize the whole farm industry. Collective farming offered such a solution; the farmer would not be deprived of his portion of the land or of its proceeds, and the employment of power machinery would in that way become economical and feasible.

To test out the practicability of the plan, and to demonstrate the results obtainable on large tract farms worked entirely by power implements and under intelligent direction, the government created at strategic points a number of large government owned farms on land not heretofore under cultivation. The results were most gratifying, and the government then began to urge the small farmers to throw their small parcels of land together into large farms. It offered tractors and other power implements to such collectives on easy terms of payment, it assigned to them agricultural experts to instruct the farmers in the best methods of fertilization, and sowing, and in the kind of crops best suited to their land. This briefly was the basic motive and the plan of the collective farm movement launched by the government, and not as erroneously interpreted abroad, an attempt to take the land away from the peasants and make them day laborers in the employ of the State.

During the past year it was estimated that of the 27 million farms six million were poor, that is, without live stock, farm implements and other means of tilling their lands. These were the farmers that generally hired themselves and their lands out to the more enterprising farmers, who had possessed before the revolution, or had acquired since, sufficient equipment to cultivate not only their own small farms but those of their poorer neighbors as well.

In the Russian scheme of things certain factors favor carrying out radical reforms on a scale that would be impossible in any other country. First, the government not only holds the purse strings, but controls effectively the entire financial and industrial resources of the country. Second, it deals with a docile and patient people, which has a remarkable capacity for endurance and self-sacrifice, and yields alike to force or intelligent leadership or to moral suasion. Third, its Supreme *(Concluded on page 106)*



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THE U. S. S. R.

(Concluded from page 104)

Economic Council and the Government Planning Commission are composed of capable, far-seeing and courageous men, who, after working out their problem carefully, have the necessary financial means as well as the zealous devotion of over a million Party members to enable them to carry out their plans and reforms. The government does not use its army, as has been reported so often, to enforce its ideas, but depends on the soundness of its ideas — from a Russian point of view — and upon moral suasion and education through the press and its party members. Over-zealous and fanatical members of the Party have repeatedly misinterpreted orders and resorted to coercive measures, but the government has promptly repudiated such tactics in every case.

The government is attaching the greatest importance to the outcome of this movement. It has appropriated large sums of money for farm aid, and has purchased great quantities of agricultural machinery abroad, in addition to its own appreciably larger production, which nevertheless is still far from adequate. It carried on an educational campaign for months, employing all the modern facilities at its disposal. It mobilized its best brains on the future of Russia, not only economically, but politically, and I was consequently not surprised when a member of the government told me that this was going to be the crucial year of their administration. If their plans succeed, they will have found the solution of the age-long farm problem, and one in harmony with their basic politico-economic doctrines. Professor Wilson, of the University of Minnesota, is here with a staff of assistants to advise the government in its agricultural program and I am told that he and his associates are expecting big results from the experiment. If they succeed, backward Russia may point to a solution of our own farm problem. Russia has about one-fifth of all the farm land of the world that is under cultivation; if the plans of the Soviet government materialize, she will in a few years have one-third. This prospect, while encouraging to Russia, in that she will then have a large exportable surplus of grain, will be disturbing to the preëminently grain-producing countries like Canada and Argentina, as it will to some extent to our own farmers.

It is well to reflect however, that the Russian people are not overfed, that the population is increasing at the rate of 3½ to 4 million people a year and that increased consumption may keep pace with increased production.

Whatever our views may be of the Soviet Government and its political doctrines, the small group of men directing the policies and the destiny of this enormous aggregation of human beings, backward but with tremendous latent possibilities, are certainly practical and courageous realists.

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INSTALMENT FINANCE

(*Continued from page 75*)

invested, E is the fixed expenses per month, W the wholesale price of the articles bought by the dealer (in this case the finance company) for resale. It is not necessary to go back to the original meanings of the quantities $B+\beta_1-\epsilon$, $\gamma_1+\beta_2$ . . . . and so on, because they can be defined for our purposes as follows:

$B+\beta_1-\epsilon$ is that part of the cash realized on each article (here an instalment contract purchased by the finance company) which is reinvested and "sold out" again, in the form of new articles or stocks, one month after the sale of the original article;

$\gamma_1+\beta_2$ is the same for two months after; and so on.

In the auto dealer's case the first payment γ_1 on the instalment contract was "delayed" another month because it took by assumption one month to buy stock, receive it and sell it out again. Here (in the finance company's case) there is no such delay, so we simply put

$B+\beta_1=\gamma_1$ (for the fate of the ϵ, see below)

$\gamma_1+\beta_2=\gamma_2$

$\gamma_2+\beta_3=\gamma_3$ . . . . . and so on, where γ_1, γ_2, γ_3, and so on, are the successive instalments of the purchased transaction. W is obviously the *advance* made by the company on the contract. We shall suppose that there is no holdback, or margin requirement. Then the term

$$\frac{\gamma_n+\beta_{n+1}}{W}\left(\frac{C-E}{C}\right)^{n+1}$$

drops out in the present case, and the stability equation becomes (on leaving out the $>$ sign)

$$\frac{\gamma_1-\epsilon}{W}\left(\frac{C-E}{C}\right)+\frac{\gamma_2}{W}\left(\frac{C-E}{C}\right)^2+\frac{\gamma_3}{W}\left(\frac{C-E}{C}\right)^3$$

$$+\ \ldots.+\frac{\gamma_n}{W}\left(\frac{C-E}{C}\right)^n-1=0$$

The meaning of this is that if this equation is satisfied, the volume v_t of new monthly deals will neither increase nor decrease as we approach the steady state (the state in which the instalments due from month to month from previous investments approach a constant value), but will approach a constant value.

Now this is obviously the condition that expenses just balance costs. ϵ was the cost of buying each unit-volume's worth of transactions. Let us begin by supposing that $\epsilon=0$, and that the sole cost is the interest charge on the invested capital, which is a fixed charge per month since the invested capital is constant. We can then represent this fixed charge by E as above. In the above form of the equation, C represents the total capital invested, including the allowance made to pay the first month's expenses. In the case of the finance company, we obviously do not want to use this quantity, but the net capital C′ invested in transactions. This causes the replacement of

$$\frac{C-E}{C} \text{ by } \frac{C'}{C'+E}$$

Now if we take $C'=1$ so that E is the monthly interest rate on the invested capital, this equation becomes identical with that for determining (*Continued on page 108*)

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INSTALMENT FINANCE

(Continued from page 107)

the *actuarial interest* (or profit) *rate per month* P, with E here taking the place of P and W representing the net advance or principal of the transaction.[6] This proves without any possibility of evasion, that if the company's expenses are a fixed charge per month on the invested capital and all cash not used up in expenses is immediately reinvested, then E is the value which this fixed charge must take in order to just balance the income from the transactions. In other words, E is here assuredly the monthly rate of profit (or rate of yield, to use the language of instalment finance), if by yield we mean the rate at which dividend charges on the capital must be fixed in order to just balance income, the other expenses for the purpose of calculation being supposed to be zero, or if we assume that all expenses (dividend charges and others) are proportional per month to the outstanding capital.

On the other hand, we can suppose that the expenses are proportional to the total volume of new transactions during a given month rather than to the outstanding amount of capital. We shall not trace the various steps, but it may be shown by means of the stability equation that the present assumption about the time distribution of costs leads to the calculation of yield on capital by assuming that the ratio of principal to interest (or profit) in each instalment is fixed $\left(=\frac{1-\epsilon}{\epsilon}\right)$ and finding the average time outstanding of the principal accordingly. This is then the method of distributing the income in current use by the finance companies of this country and it gives the true yield rate, provided that we can assume that the expenses of the business are such that they can be considered equivalent to charging a certain fixed percentage ϵ for the volume of new transactions made during the month for which the charge is calculated.

(Concluded on page 110)

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INSTALMENT FINANCE

(Concluded from page 108)

THUS a system of calculating yield of distributing income more closely approaching reality would probably combine the features of the above two systems. The actual course of the business will determine what the earned income really is (i.e., the actual fixed and running expenses including allowance for profit) and it is from this distribution of earned income, so determined by an analysis of the business, that one must find out how to make the yield calculation, and in particular how to rationally fix the interest charges for any new kind of transaction one may contemplate using.

Principal should mean the particular sum of money whose history and vagaries determine the interest. Principal should also be the total advance on a transaction, since that is the capital invested in it, and it is the history and vagaries of this capital which determines the yield obtained on it. Certainly no other data are required to calculate the interest earnings than a statement of how much capital is outstanding during each successive period and the rate at which the outstanding capital is earning interest in each period, if that can be given; it is the quantity of the principal together with the average outstanding time of the principal that determines the interest.

But history cannot be invented beforehand in one's own study: it has to be discovered by looking at the actual events. So the history of the capital can only be found by considering an actual business (or making up a hypothetical one which can be considered typical) and as different businesses can well have different histories, it thus happens that there are several and many ways, correct ones, of calculating the yield on the capital, each one being, however, correct only for the particular kind of capital history which was assumed in deriving it. In any event and in any case the yield is to be and can be calculated ultimately by analyzing the costs, as has been said.

1. "Instalment Finance and the Efficient Use of Capital," *Harvard Business Review*, July, 1930; "Mathematics of Instalment Finance," *American Accountant*, July, 1930; "How Much Instalment Business Can I Do," *System*, April, 1930; "Capital Turnover Factors in Instalment Sales," October, 1930, *American Accountant;* by Otto C. Lorenz.

2. Decisions have been made by the United States Board of Tax Appeals accepting this method in the case of the following companies: Federal Services Finance Corp. of Washington, D. C.; 1st National Bank, Sonora, Texas; Chatham & Phoenix National Bank, N. Y.

3. "Capital Turnover Factors in Instalment Sales," *American Accountant*, October, 1930, by Otto C. Lorenz.

4. "Yield Per Cent Problems, etc." by Bruce Crawford Bailey; a series of tables published by Professor Floyd C. Emmons, Michigan Agricultural College; also an article in the March 1929 issue of the National Association of Finance Company *News*.

5. See the March 1929 issue of the National Association of Finance Company *News*.

6. This equation is not given here because of lack of space, but may be described in a subsequent article.

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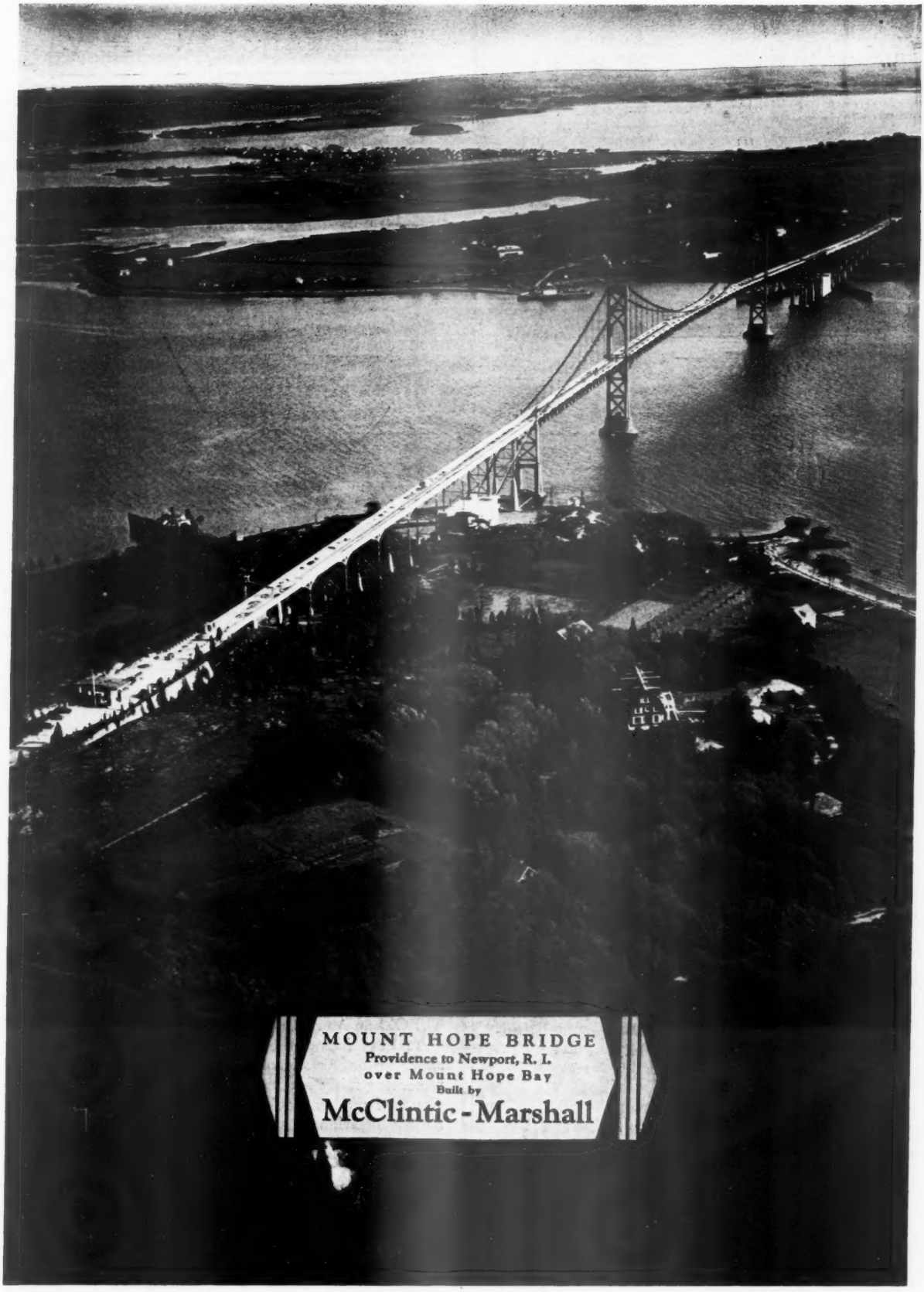

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Solves the ozone problem for rubber insulated high tension cables

The usual methods of attempting to solve the corona and ozone problem in relation to cable insulation, to prevent ozone cuts such as are shown in the illustration, have been with metallic shields, protective coverings or with so called ozone proof, ozone resisting or ozone repelling insulation.

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"ANOROC" insulation retains all of the electrical, chemical and physical properties which have made rubber the most adaptable and desirable insulation for cables.

Further information and details of tests are contained in a recent Simplex publication entitled "Corona Prevention and Ozone Elimination". May we send a copy to you?

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THE TABULAR VIEW

HAROLD B. RICHMOND, '14, author of "Radio's Growing Pains" in this issue of the Review, is especially qualified to write upon the problems of the radio industry. As a prominent figure in the radio field, he presents here information that is authoritative, and nowhere have we seen such a lucid explanation of the complicated patent situation that faces the radio industry or of the difficulties besetting the Federal Radio Commission. ¶ Last year Mr. Richmond was President of the Radio Manufacturers Association and at the present time occupies the position of Treasurer of the General Radio Company in Cambridge. During 1916 and 1917 he was a member of the instructing staff of the Department of Electrical Engineering at the Institute, and he has always been active in Institute affairs. His home is in Winchester.

THE article on aerial mapping was also written by a Technology graduate, Crockett A. Harrison of the Class of 1926. Mr. Harrison has worked in various aviation fields since his graduation from the Institute, and at one time he was engaged in aviation journalism. He is now in charge of Fairchild Aerial Camera sales in addition to doing advertising work for the Fairchild Airplane Manufacturing Corporation and Fairchild Aircraft, Ltd., of Montreal. ¶ Like radio broadcasting, the science of aerial surveying and mapping has grown from infancy to adulthood in the short period of ten years. Vast areas of the earth's surface never before mapped accurately are now being mapped and surveyed by airplane. Mr. Harrison describes the methods used in making the airplane and camera tools for the surveyor and cartographer.

KARL T. COMPTON needs no introduction to Review readers for, apart from his position as President of the Institute, he is well known as one of the most distinguished of living physicists. His article appearing in this issue of the Review is based on an address prepared by him for the radio. ¶ This is the second article the Compton family has contributed to the Review this year. Dr. Arthur Compton, author of "Looking Inside the Atom" which was published in the October Review, is President Compton's brother.

FROM an American engineer in Germany we learn the real opinions of the German people about Americans and the era of Americanization. The criticism is unbiased, presenting fairly and clearly the foreign attitude on this phase of modern society. In the light of this article Americanization is a growing movement — a modern tendency — not merely a patriotic and national characteristic. ¶ Hunter Rouse, '29, holds a fellowship from the Institute for the study of Hydraulic Engineering in Germany. In the time that Mr. Rouse has lived abroad, he has learned much that the summer traveler cannot possibly apprehend during a short sight-seeing visit.

(Continued on page 116)

*The Commons Room of the New Technology Dormitory is floored with *CELLized Oak Blocks, size 11¼" square. Architects — Coolidge and Carlson, Boston. General Contractors — Chase and Gilbert, Boston. Flooring Contractors — Bloom, South and Gurney, Inc., 176 Federal Street, Boston.*

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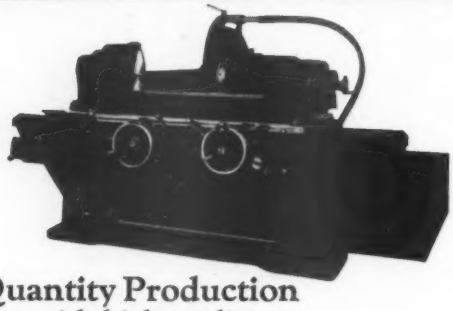

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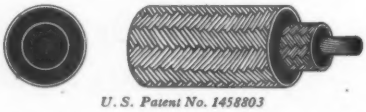

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THE TABULAR VIEW

(Continued from page 114)

OUR book reviewers for this issue are Messrs. Tenney L. Davis, George W. Adams, and Clair E. Turner. Mr. Davis has been a member of the Institute's faculty in the Department of Chemistry since 1919. He is also active in the American Chemical Society and was appointed Secretary of a division of the history of chemistry in 1927. Beside contributing other book reviews, he was the author of "Primitive Thinking," an article which appeared in the July (1929) Review on the beginnings of authentic science. ¶ Mr. Adams was formerly an instructor in English and History at Technology and is now studying at Harvard for his Ph.D. in History.

PROFESSOR Clair E. Turner, '17, is a leader in the field of public health work and training and a member of the Department of Biology and Public Health at the Institute. The phase of public health in which he is most interested is child health and its promotion in big public school programs. His belief in the value of visual aids in learning has led him to direct the filming of several highly interesting and informative motion pictures dealing with health subjects. Besides lecturing in this field he has written several books on health. The Public Health movement has become international in scope, and in 1927 Professor Turner became Chairman of the Health Section of the World Federation of Education.

THE REVIEW takes pleasure in announcing that it has arranged with the Scientific Book Club, Inc., to publish each month the books selected by that organization's Editorial Committee as the outstanding scientific books of the month. The book marts are flooded with popular science books, many of which are worthless and misleading in their information. It is the purpose of the Book Section of the Review to point out scientific books that are accurate and worthy and to present the comments of authorities on a few of these titles. By presenting the selections of the Scientific Book Club, Inc., we are enlarging the scope of this department for the benefit of the Review's growing roster of readers.

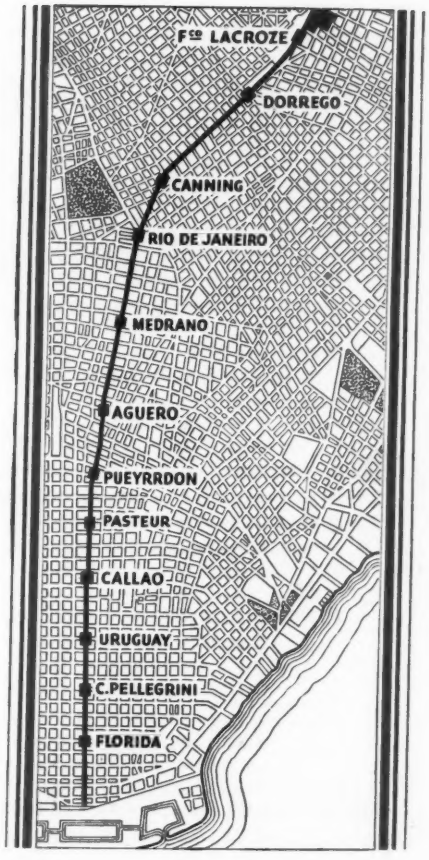
"INDUSTRY and Engineering in the Union of Socialist Soviet Republics" which the Review published in October and November created widespread comment. Among the letters received, the Review is happy to present the following.

To the Editor:

"I returned from U.S.S.R. a few weeks ago, where I lived for seven months of this year. The articles in the Review on 'Industry and Engineering in the Union of Socialist Soviet Republics' were of great interest to me, as they offered an opportunity to compare notes on that fearful country. While reading the articles, I could not dismiss two thoughts from my mind: One was that the anonymous engineer's impressions were produced in Moscow. The other, that he was probably in an advisory

(Concluded on page 118)

First modern subway *in South America* built in 21 months



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THE TABULAR VIEW

(Concluded from page 116)

capacity and missed the trying but instructive task of working day after day with the Soviets upon whom the Moscow Dictators depend for the execution of details.

"Having been slightly deranged by the profuse display of red table covers at committee meetings, I shall employ the Soviet method of destruction in stating my variances with the author's views. I was surprised to know of the dancing, as public dancing was absolutely prohibited in our city. House parties were allowable, and I attended one at a Communist's apartment. The decrease in liquor consumption was not evident there, in spite of the rise in price of cognac to $12 a liter.

"Working four days and attempting relaxation the fifth proved a constant strain to our commission. I think that the Russians are similarly affected and predict a gradual decrease in production due to health failure. At times they are forced to work the fifth, never regaining their lost rest day. The five-day week may have been 'purely economic,' but many a Moscow edict smacking of 'Industrialization' severs the tree from its roots. In Russia, the Church was the tree, its roots about 90 per cent of the people.

"My experience was that waiting crowds not only indicated 'very bad management' but generally a lack of everything. Our only abundance was in matches and kerosene, but who in hell can live on kerosene? About one-third of the eggs (if available) in government stores were rotten. Half the time, the milk was sour when purchased, or soon turned.

"The greatest strain on me, however, was at the office. Try as we might for weeks, we could get nothing to do. Then, we would be overwhelmed and work nights, only to find that someone had changed the requirements or location just before the plans were completed. Once I waited three weeks for information on railroad grades; then what I received was not right. The Russian in charge of us spoke excellent English, and he, personally, cooperated as well as he could. He had lived in America for many years. One morning he came to the office and on his door was a notice to the effect that he had been replaced. His successor, an ardent Communist, was a laborer with a few years' university training. No wonder the Five-Year Plan, or any other plan, fails.

"Now, the question is: who must shoulder the blame in 1933, when the Five-Year Plan is due to be completed? The Communistic Party? Never! The Soviet Engineers? Possibly some. The Foreign Specialists? Probably. The Germans were involved a few years ago and the British a few months ago. Now, there is a large demand for American Engineers in Russia."

Russell W. Ambach, '24.

HAROLD B. WARREN executed the water color which is reproduced on the cover of this issue. For many years he has been a Professor of Landscape Architecture at Harvard University and in 1916 and 1917 he was a Professor of Architecture at the Institute.